Science and Invention

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When a Comet Strikes the Earth

By Dr. H. H. Sheldon

Hunting with African Giants and Pygmies — By Paul L. Hoefler

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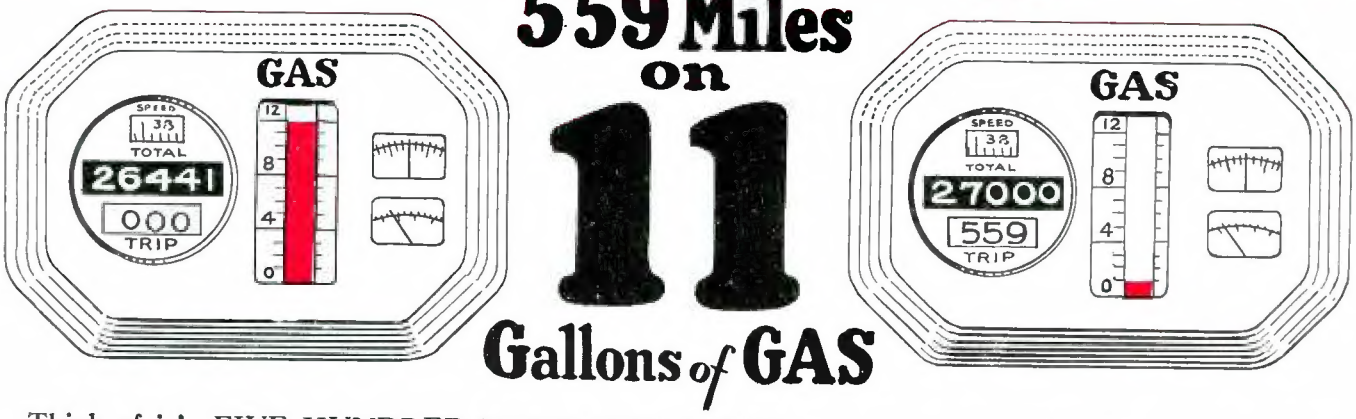
Over the Mountains from Los Angeles



Think of it! FIVE HUNDRED FIFTY-NINE MILES over rough mountainous country burning only ELEVEN GALLONS OF GASOLINE. Imagine more than FIFTY MILES to the GALLON. This is what the WHIRLWIND CARBURETING DEVICE does for D. R. Gilbert, enough of a saving on just one trip to more than pay the cost of the Whirlwind.

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Broadcasting stations need trained men continually for jobs paying $1,800 to $5,000 a year.

Television—the coming field of many great opportunities—is covered by my course.

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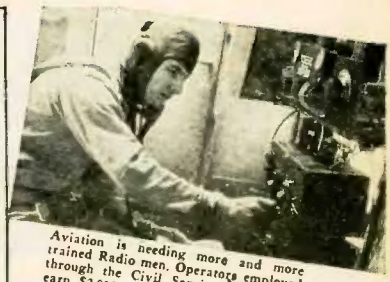

Aviation is needing more and more trained Radio men. Operators employed through the Civil Service Commission earn $2,000 to $2,800 a year.

Talking Movies—an invention made possible only by Radio—offers many fine jobs to well trained Radio men.

You'll Get *Thrills*-Adventure BIG PAY in RADIO

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J. E. Smith, Pres.

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Earn While You Learn

You don't have to quit your present job to take my course! You stay right at home, hold your job, and learn in your spare time. (Lack of high school education or Radio experience are no drawbacks.) I teach you to begin making money shortly after you enroll. My new practical method makes this possible. I give you eight big laboratory outfits that teach you to build and service practically every type of receiving set made. Many of my students earn $15, $20, $30 weekly while learning. Earle Cummings, 18 Webster St., Haverhill, Mass., writes: "I made $375 in one month in my spare time, installing, servicing, selling Radio sets." And let me emphasize right here that a Radio business of your own is one of the money-making opportunities my training prepares you for in case you wish to settle down at home.

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Send the coupon below for my 64-page book of opportunities in Radio and information on my home-study training. It has put hundreds of fellows on the road to bigger pay and success. It will tell you exactly what Radio offers you, and how my Employment Department helps you get into Radio after you graduate. I back my training with a signed agreement to refund every penny of your money if, after completion, you are not satisfied with the Lesson and Instruction Service I give you. Fill in and mail the coupon NOW!

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National Radio Institute,
Washington, D. C.

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National Radio Institute, Dept. IES
Washington, D. C.

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Address.....

City..... *State*.....

Occupation.....

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"Dear Mr. Smith: I have worked as Junior Operator on board S. S. Dorchester and Chief Operator of the Chester Sun. I have travelled from 75,000 to 100,000 miles, visited ports in various countries, fished and motored with millionaires, been on airplane flights, etc. I am now with Broadcasting Station WREN." (Signed) Robin D. Compton, 1213 Vermont St., Lawrence, Kansas.

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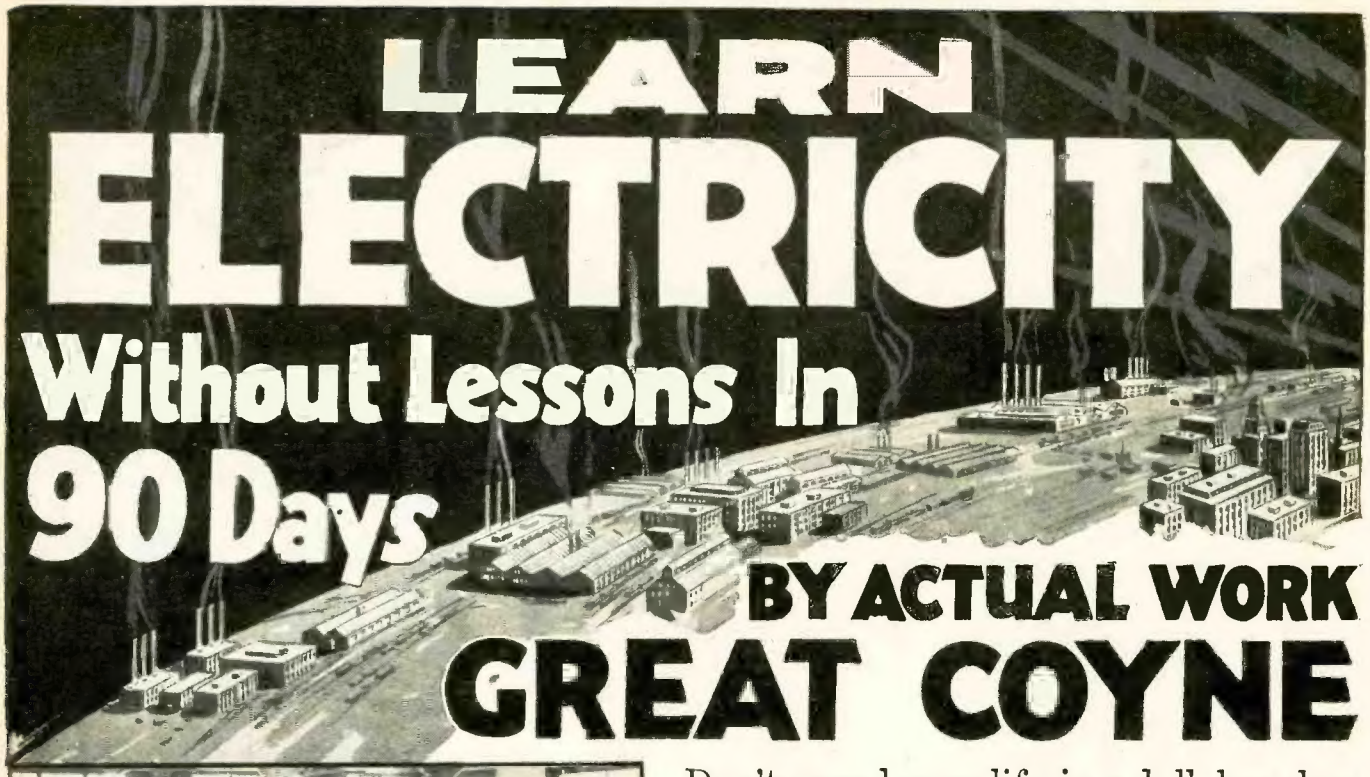

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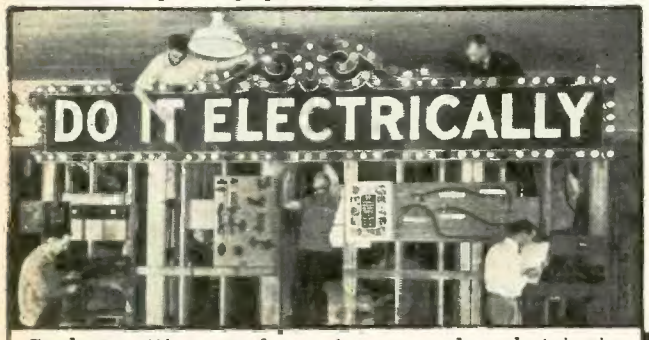
Students working in our Alternating Current Department

Instructor explaining operation of modern airplane motor



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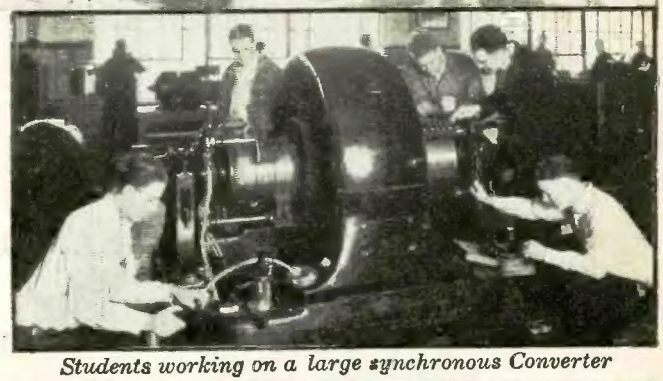
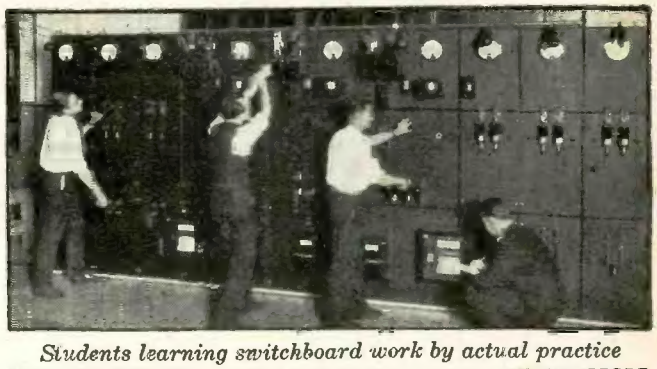
Electrical School

Dept. 51-02 **CHICAGO, ILL.**

MY FREE BOOK →



Students working on a large synchronous Converter



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500 S. Paulina St., Chicago, Ill.

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MAY
1931

Science and Invention

VOL. XIX
No. 1

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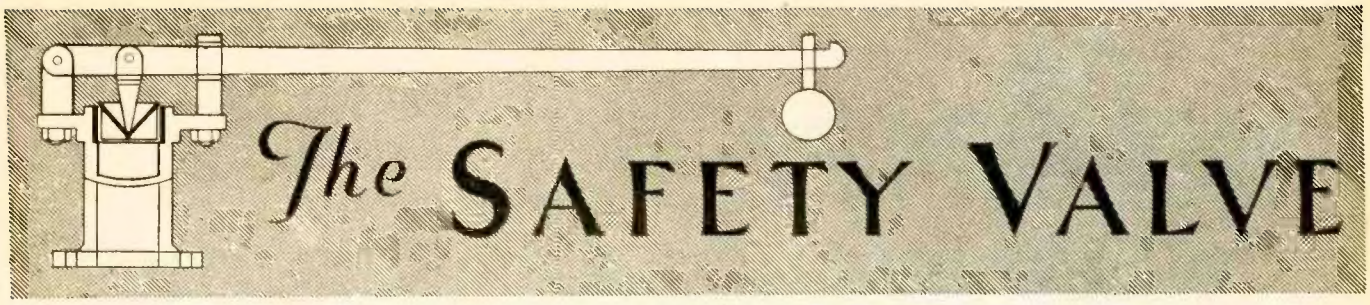


This Department Is Conducted By and For You. Expressions of Opinion or Comments Are Welcome. Please Address Them to Safety Valve Editor, in care of this publication.

A Compliment from Brussels

I WONDER if you would be surprised to hear from Brussels, such a small place compared to your big cities. I live in Brussels and since last year I have followed with much interest every monthly issue of SCIENCE AND INVENTION magazine. I used to buy two magazines in this field (both of them American publications), but now, after due comparison, I have subscribed to your publication only. I find this by far the most interesting.

Do you know that here in Brussels, when one buys an individual copy of your magazine one has to pay 50 cents per copy, but when you subscribe for one year it amounts to 30 cents per copy?

May I say that I particularly enjoy your articles on Hints for Mechanics, Chemistry, Handicraft, etc. But . . . I would like to see a bit more about photography. My reason for this is that photography is my personal hobby.

Please tell your readers that if I can be of any service to them here in Belgium, I am prepared to do so.

MICHEL DUCUROIR,
Brussels, Belgium.

Well, Well

WHILE looking through your article in the February issue of SCIENCE AND INVENTION I saw quite a number of remarks on perpetual motion. You seem to think it has not been conquered, but "if" I am not mistaken it has.

While visiting the Peabody Museum, I came across something I think is perpetual motion. Just as I entered the door I encountered a large shaft which extended from the first floor to the roof. There is a large pendulum hanging in this shaft, and ever since it has been hung there it has been in constant motion.

A. C. TINGLEY,
New Haven, Conn.

In Favor of Mathematical Department

I HAVE just become a reader of your magazine and find that, after one trial, no other can excel this publication.

In reply to C. H. Chittenden's letter, published in your February issue, I want to express my opinion. His suggestion would be an added asset to your already wonderful magazine.

As I take a great interest in mathematics, I, for one, will "boost" this plan for conducting a mathematics department on the order of Dunninger's magical articles.

C. H. Chittenden also gave excellent illustrations of what this mathematical department could be made up of.

MORRIS BRANDLER,
Hempstead, N. Y.

Calcium in the Blood

A QUESTION has come up in my mind, an answer to which will undoubtedly interest a fair percentage of your readers.

Recently Professor Elmer Culler of the University of Illinois reported to the American Psychological Association, in Iowa City, that neurotic individuals, who are oversensitive, self-conscious, moody, apprehensive and diffident, have less calcium in their blood, more sugar and less hemoglobin, which makes blood red, than have non-neurotic people who are well poised, self-confident, and sociable. It seems there is a possibility of rendering neurotic individuals non-neurotic by a simple remedy for the blood conditions. As to the method of bringing about a change in the composition of the blood, there seems to be quite a few to choose from. For example, calcium may be injected into the blood in the form of suitable compounds and in like manner the presence of the other constituents mentioned may be controlled. Another method is the use of medicines or the neurotic individual may be placed under a special diet resulting in a gradual alteration of composition of the blood. This is pure imagination on my part, so I would greatly appreciate information on the subject.

ALFRED J. MASTROPOLE,
New York, N. Y.

(While it has been ascertained that neurotic individuals have less calcium and hemoglobin in their blood, it does not follow that these deficiencies actually cause the oversensitiveness of the individuals. In other words, the diminution of calcium does not cause the neurosis, but a neurotic individual usually and always has a calcium and hemoglobin deficiency. It is doubtful if the injection of calcium will make a patient less moody.—EDITOR.)

That San Francisco Bridge

I WAS very much interested in a write-up in your magazine for November, giving data on the big suspension bridge across the Hudson River. San Francisco and the California North Bay counties voted at the November election for a bond issue of $35,000,000 for a suspension bridge, connecting San Francisco and Marin County. This bridge will be 700 feet longer in span than the Hudson River Bridge.

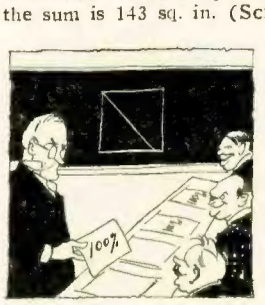
The bonds carried by a three-to-one vote.

J. A. REEDER,
San Rafael, Calif.

(The Golden Gate Bridge was featured in SCIENCE AND INVENTION *magazine when the plans were first drawn up. From time to time photographs of the progress in the construction will appear in this publication.*—EDITOR.)

Not Mathematically Inclined for This One

IN regard to the problem of C. H. Chittenden. He is hytrated. A piece of paper, 11 × 13 inches, cut diagonally and slit one inch, measured on the perpendicular, will measure, neglecting the two triangular corners, 12 × 11 55/64 = 142.40625 sq. in. The two triangles laid together will form a figure 1 × 19/32 = .59375 sq. in. Add the two and the sum is 143 sq. in. (SCIENCE AND INVENTION, Feb., 1931).



There are other problems of the same sort, but why take valuable space with such bunk? Give us something scientific.

For instance: How to make and use a miniature arc furnace.

I am very much interested in SCIENCE AND INVENTION magazine, and it has helped me with many problems. When I am badly stuck, I look through the advertisements and I soon find the article that I need. One of my hobbies is making measuring instruments, particularly verniers, and I have evolved a method of laying out straight line and circular vernier scales, using ordinary hand tools. I wanted to put index or guide numbers on these scales. Stencils, engraving and etching with acid were out of the question. A small, low-priced instrument advertised in your magazine proved to be what I wanted. Other experimenters should bear this in mind: When in doubt, look through SCIENCE AND INVENTION'S ads. I don't like your contests in which money prizes are offered. There are so many ideas submitted

(*Continued on page* 70)

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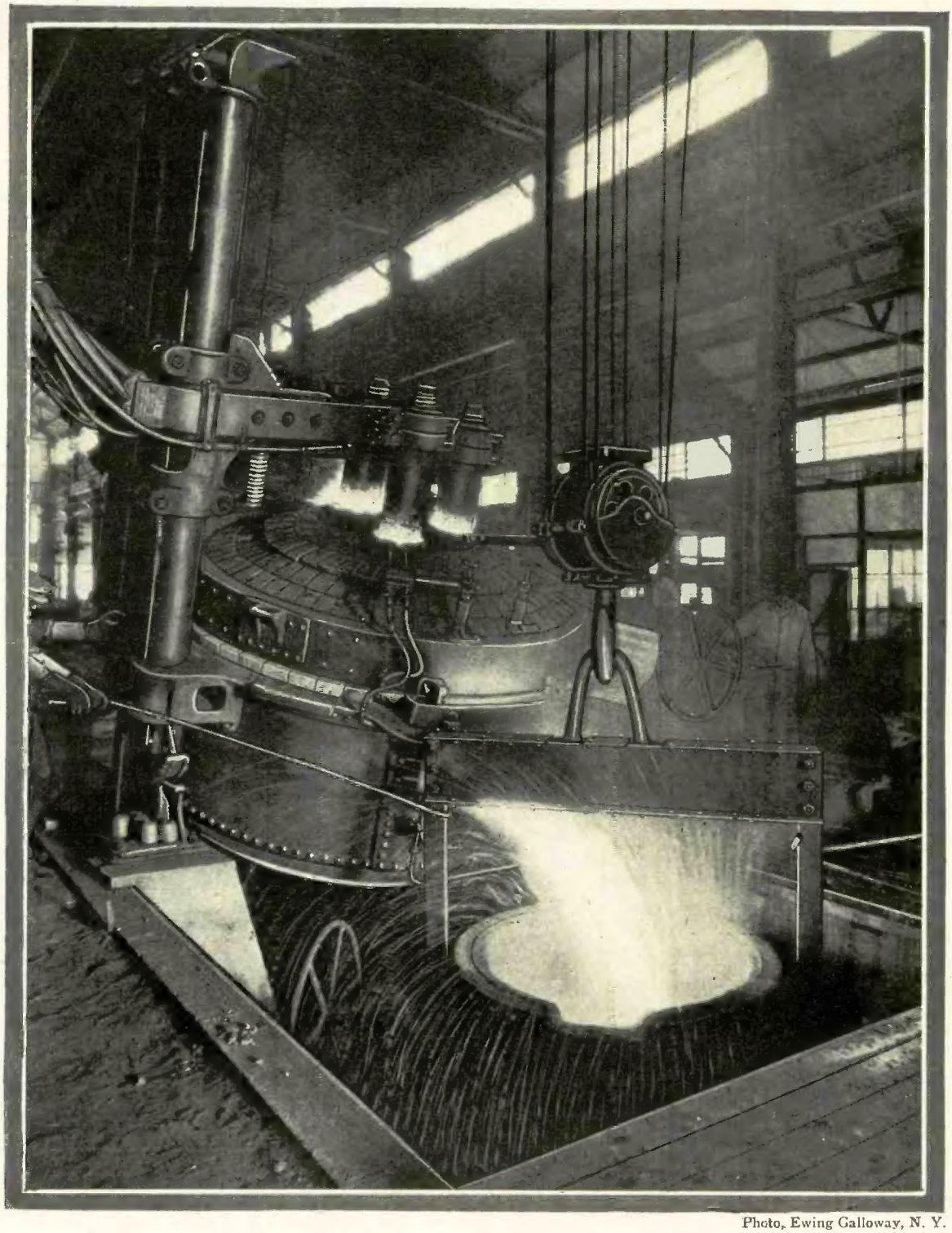
This Age of Steel



Photo, Ewing Galloway, N. Y.

Pouring Molten Steel From a Herault Electric Furnace in the Main Plant of the Hughes Tool Company, Houston, Texas. With Up-to-Date Equipment Like This, It Is Not Surprising That Modern Tools Are Good.

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MAY, 1931
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Editorial

Hypnotism—A Disappearing Art

MANY who read this editorial will remember the days when nearly every eight act vaudeville show had its professional hypnotist. This man more often than not had his "plant" in the orchestra, who came up on the stage when the hypnotist called for volunteers from the audience.

The word "plant," used in the above sentence, is vaudeville vernacular applied to a person purposely "planted" or placed among the audience, who acts in collusion with the performer and who has been carefully rehearsed in the part he is to play.

Perhaps many others will remember even further back into the history of hypnotism, when hypnosis was looked upon as the panacea for all ills to which human flesh is heir.

Colleges for the express purpose of teaching hypnosis sprang up here and there in those days.

Great care was taken to instruct the operators on the subject of cleanliness of mind and body. The Mesmeric passes (named after Frederick Anton Mesmer, an Austrian doctor, who attracted crowds because of his professed ability to effect cures by manipulation alone) were carefully rehearsed and unduly stressed.

And then, a sudden demise of hypnosis in general, with here and there a break in the news, telling of a new spectacular stunt by some fakir professing to be able to place himself in a cataleptic state and be buried alive for half an hour or more.

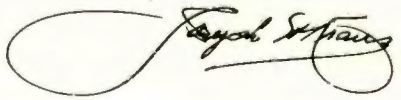
While studying medicine at Long Island College Hospital, Dr. Cardwell, Professor of Physiology, delivered some extremely interesting lectures on hypnosis to the class which the writer attended. Strange to say, there were none of the flamboyant passes of hands so necessary to the vaudeville demonstration. There were no shaking, trembling fingers directed at the subject, nor did the professor stare into the subject's face with a pair of piercing black eyes, framed by the black rim of hair on his head, face and chin. In spite of the omission of mysterious motions, the subjects picked from the class at random went into deep trances.

One could readily reason that if one person can hypnotize another, then any one of the same mind can control another willing subject. Experiments bear this out. Modern authorities to the contrary, I dare say that 100% of the same-minded population can be both hypnotists and subjects. The field of hypnosis has been sadly neglected. The French visitor to our shores, Emile Coué, revived it after a fashion; so did Freud. But as yet, no one has perfected a machine to administer doses of sleep, as Morpheus did when he poured somniferous vapor out of his horn.

Eye strain or fatigue is helpful in inducing hypnotic sleep. A machine can easily be developed to do this.

Naturally, such research will lead into far greater acknowledgment of the benefits of this art. Minor and even major operations have been performed under hypnotic control of the subject, who felt neither pain nor discomfort. An entire column picked at random from a newspaper has been memorized after reading it but once when the subject was under hypnotic control. Involuntary muscular twitchings have been stopped and addicted vices abrogated. From a strictly psychological standpoint, melancholia suppressions, depressions and, what is even greater, fears have been allayed or vanquished completely.

Let the psychologist and the inventor engage himself on the task of developing a machine that will induce a hypnotic state. It can be done. There is plenty of opportunity for really ethical research in this fast disappearing art.



"Those Who Refuse to Go Beyond Fact Rarely Get as Far as Fact" - - - - - - - - HUXLEY

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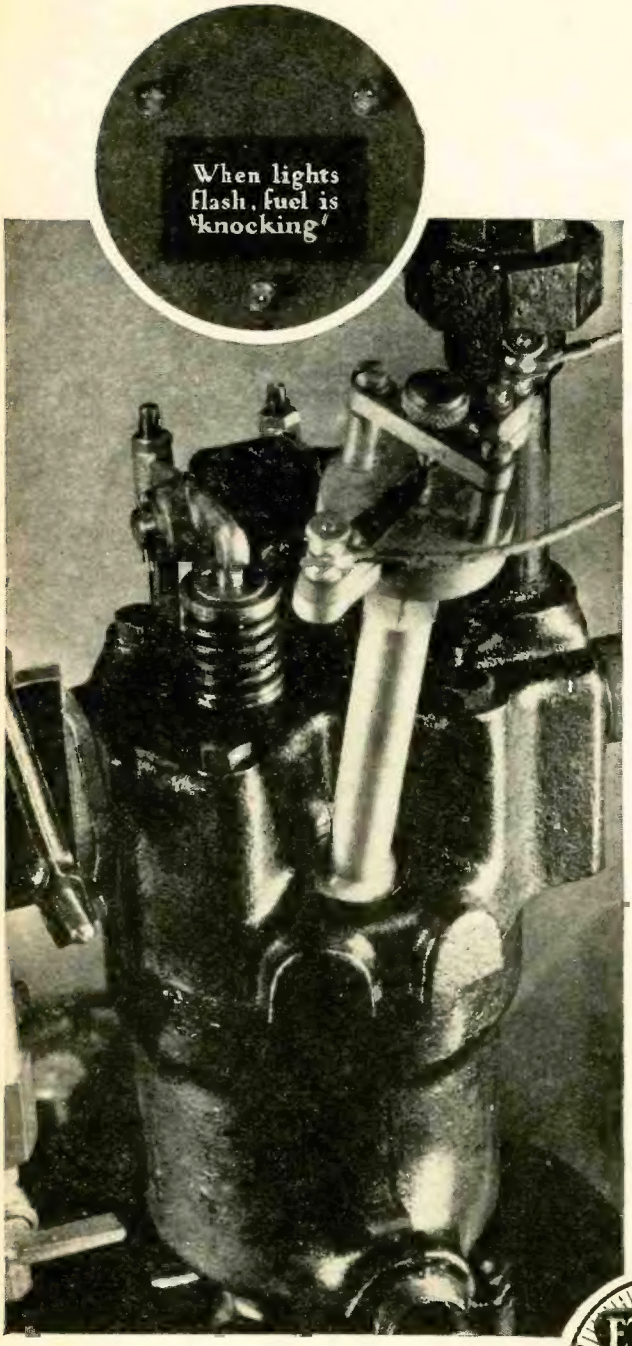
This PIN *tells fortunes for* Gasoline



The Bouncing Pin forms an electrical contact that flashes the light above whenever gasoline is not exploding evenly. It does not flash this warning signal when the fuel is Ethyl Gasoline. Ethyl fluid prevents uneven explosions.

THE Bouncing Pin, it is called: because it bounces on the breaking point of gasoline efficiency.

Ordinary gasoline has a tendency to explode too quickly under the strain of cylinder pressure; causing power-waste, overheating, and causing in its worst form the banging impact of gas against cylinder walls that you call "knocking."

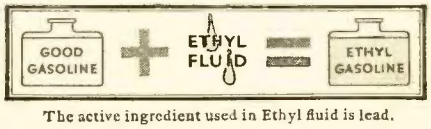
The Bouncing Pin detects power-wasting explosions even before they are bad enough to cause audible "knocking."

Before any gasoline is mixed with Ethyl fluid it comes to the Bouncing Pin to have its fortune told—to find how much Ethyl fluid is needed in each gallon to prevent shattering explosions under the strain of high pressure.

At the same time the gasoline is tested in other machines for purity, quick-starting, and other desirable qualities. Then, after Ethyl fluid has been added to this good gasoline in needed quantity, it comes back to the Bouncing Pin to make sure combustion goes forward with the smoothly increasing pressure that enables Ethyl Gasoline to bring out the best performance of any motor.

Ninety-five leading oil refiners now take advantage of the combustion control that Ethyl fluid gives to good gasoline. You will find their products for sale at pumps all over the country. Every Ethyl Gasoline pump is marked with the Ethyl emblem.

In your car, Ethyl Gasoline will give you greater power, with less overheating, and no "knocking." It will cause less wear and tear on the motor and give you smoother, quieter performance because its combustion is controlled. Ethyl Gasoline Corporation, Chrysler Building, New York City.



The active ingredient used in Ethyl fluid is lead.

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ETHYL GASOLINE

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Science and Invention

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When a Comet Strikes the Earth

By Dr. H. H. Sheldon

Professor Sheldon Is Chairman of the Physics Department at New York University; Fellow of the American Association for the Advancement of Science; the Acoustical Society of America; the American Geographical Society; and a Member of the American Physical Society. He Is Also President of the New York Electrical Society

THOUSANDS of years ago the animals which inhabited the earth were stopped in their tracks; birds went flying crazily to shelter; man, if he existed at that time, fell to his knees and prayed to whatever gods were then popular. The earth shook and swayed beneath their feet. For days they did not dare to venture forth from their shelter. And then, only because the need for food made it imperative. The earth had received the worst wallop it has had since its formation. A direct hit had been scored upon it from interstellar space.

Many thousands of years later civilized man, man as we know him today, stumbled upon the peculiar scar that was left on the earth by the tremendous impact of this gigantic projectile and wondered at its peculiar shape. Here, in Arizona, was a giant crater, 4,000 feet in diameter, surrounded by a ragged land formation, resembling a wall, about 120 feet high. It looked a good deal like one of the huge craters so evident on the surface of the moon, when viewed through a telescope.

During recent years this crater has been the subject of much investigation. It has been variously known as Coon Butte, Meteor Butte, The Meteor Crater, and, more recently, the Barringer Crater. The last name has been given it as a mark of respect to the Barringers, father and son, who carried on such prolonged research in its connection. How did the crater get there?

Ewing Galloway

This white-hot ball, with its equally blazing tail, reappears about every 76 years, passing sufficiently near the earth's orbit to hurl down meteoric showers. It is called Halley's Comet; the above photograph was taken at Santiago, Chile on May 7, 1910, when it last appeared.

Perhaps the name, meteor crater, is such as to suggest to the reader not familiar with the crater that it may have occurred as a result of a collision of the earth with a meteor. This is generally considered as one possibility; but it is not the only one. At first sight the crater has the appearance of a rim of an old volcano, gradually sunk into the earth, until only its edge remains above the surface. Until considerable research had been done to prove otherwise, this theory was somewhat generally held. It has been completely disproven, however, by extensive borings which show that the floor underneath is continuous with the surrounding rock strata. Large numbers of borings have been made in all parts of the crater to depths of nearly fifteen hundred feet. Further, there are no materials found in the neighborhood that are suggestive of volcanic origin.

A second theory, likewise now generally discarded, is that the crater was formed by erosion. True, the walls of the floor of the crater itself all bear deep scars of erosion. This is not to be wondered at, in view of the fact that it has withstood the torrential downpours of the desert for centuries. But were it due to erosion, and merely a sinkhole, it would be difficult to account for the surrounding walls. It has been said that the particular kind of rock which lies beneath it, Kaibeb limestone, is quite sponge-like in character. In other places where this

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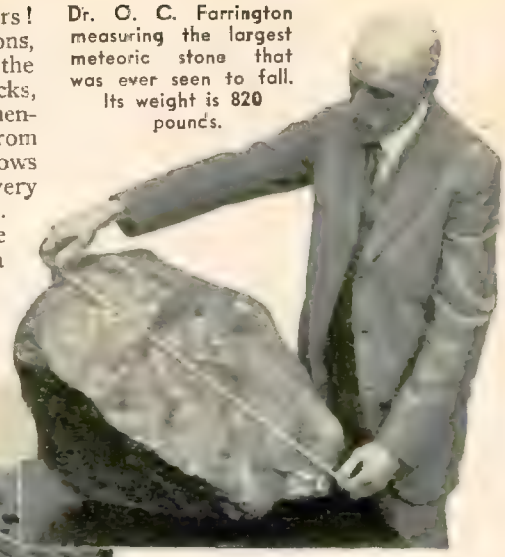
rock occurs, small sinkholes have been found. If this theory were correct, it is strange that no craters to compare in size with the Barringer Crater appear elsewhere.

It must be admitted, then, that the most likely thing that could have produced this peculiar crater was a direct hit by a very large meteor arriving on the earth with terrific velocity, or possibly by a collision with a comet. Whatever it was, the earth must have been shaken like a ship is shaken when it strikes a rock. It must have been the most awe-inspiring sight that living eyes have ever had the opportunity of witnessing.

Imagine, streaking out of the sky, a huge mass of material, perhaps four hundred feet in diameter, and trailing behind it a long tail of white hot matter, burned by the heat of friction with the air! Picture this huge white-hot ball striking the earth with a thunderous impact that nearly shatters the ear drum. Dust from powdered rocks fills the atmosphere, while the earth fairly stops in its tracks, and shivers! Then follow unimaginable explosions, like cracks of thunder piled one on the other. Water, in the saturated rocks, has been turned to steam by the tremendous heat caused by the impact from this giant missile. Dust cloud follows dust cloud, until it seems that the very earth is being rended apart, for miles.

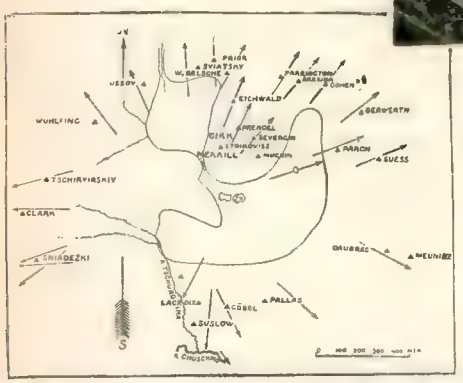
Hours after, when winds have cleared the atmosphere, there is a new row of hills visible at a distance. On going close they are found to have been formed by the dust which has heaped up around the center of disturbance. They form a closed circle, and the whole resembles a huge arena formed to stage the world's most spectacular drama. Nodules of iron, perhaps still hot, are found for miles around. It is these, which, centuries later, form the major clue to what took place at this point of the earth's surface.

With this picture in mind let us examine the ground in more detail. What became of the comet has always puzzled geologists. Here is the crater—where is the missile that made it? For a long time it was thought to be buried deep beneath the floor of the crater. But the same borings which show that it cannot be a volcano show also that

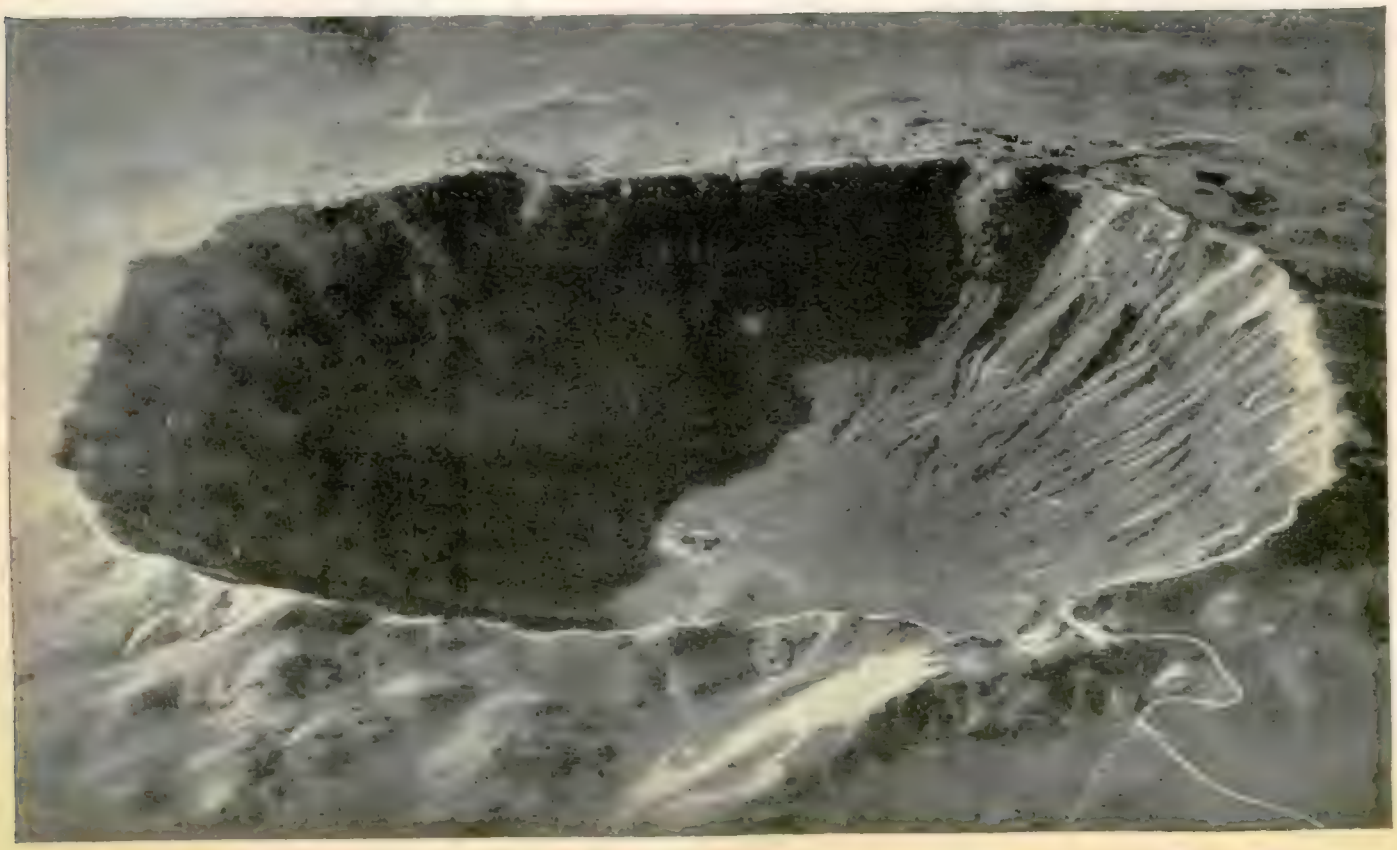


Dr. O. C. Farrington measuring the largest meteoric stone that was ever seen to fall. Its weight is 820 pounds.

A devastated forest, photographed by Professor L. A. Kulik of the Siberian Meteor Expedition. Trees were thrown down by the terrific wind created at the time of the meteor fall, which occurred on a plateau in Siberia, between the rivers Kimtchu and Huchma.



Map of the affected region, also provided by Professor Kulik. Arrows indicate the direction in which the trees fell, away from the center of the disturbance.



The famous Meteor Crater, or Barringer Crater, near Winslow, Arizona. The meteor has entirely disappeared.

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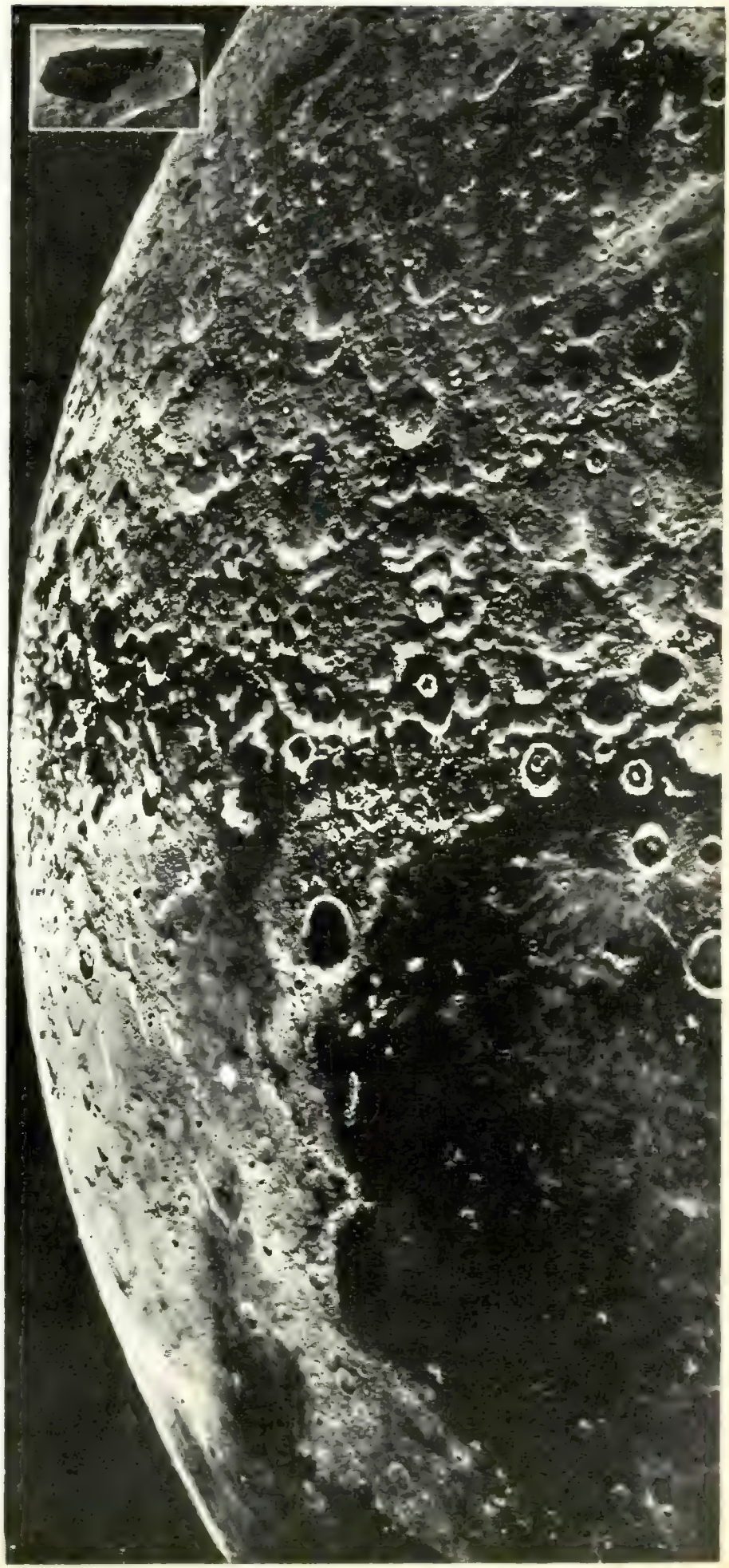
there is no buried meteor. Drillings have been made at suspected spots around the edge, on the theory that it may have struck the earth at an angle and so have been stopped, not underneath the crater, but off to one side. While meteoric material has been brought up from depths as great as 1,376 feet, there has been no evidence of the presence of the meteor itself. The result is that we are driven to the conclusion that the meteor was completely destroyed by the impact.

Naturally our curiosity as to what the meteor was like, in the first place, leads us on. How big was this meteor, how fast was it going when it hit the earth, and of what was it composed? On the assumption that the meteor was composed wholly of nickeliferous iron, calculations indicate that it may have been about 4,000 feet in diameter and weighed some ten million tons. Only a few tons of iron are now left. But this is not at all surprising, for iron quickly oxidizes when exposed to the air. That is why so few meteors are found after they have been seen to fall. The iron nodules, of which several tons have been discovered around Meteor Crater, are those which were of a resistant nature.

But whether or not the meteor was wholly of iron is open to question. The Barringer theory is to the effect that the meteor was composed of many fragments of iron not bound together. These formed the immense cluster which made up the meteor. If any stone had been present in the cluster it would have been ground to powder, as if in a ball-mill, and would have been separated from the comet, or meteor, by pressure of the sun's light. There is to be found no stone near the crater that is foreign to the region.

On the other hand, Professor Herman L. Fairchild, noted geological authority of the University of Rochester, believes that the iron nodules must have been bound together by rock. If this were not so, he feels that the desert would have been pitted by smaller craters produced by pieces of the meteor separated from the main body by the friction with the earth's atmosphere. He believes that the pieces of iron found in the region should show evidence of friction with the air through which they must have passed with terrific velocity. They do not. He therefore thinks that they arrived protected by a rock coating. This rock coating might have been powdered so fine as to have completely disappeared from the region. Individual sand grains were shattered so fine, possibly by supersonic vibrations, that they produced dust of angular crystalline quartz of microscopic fineness. Fifty-five per cent of these dust particles will pass through a 200-mesh sieve.

It has been objected that if the iron particles were (*Continued on page* 85)



When the moon was hot enough to be plastic, it must have received many comet bombardments. Some of the craters on its surface are 500 miles across and ten miles deep. They resemble the Meteor Crater, cut in on the top of the photograph.

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Giraffe photographed near a giant ant hill in Tanganyika Territory, near the N'goro N'goro crater. These animals, despite their ungainly appearance, can run as fast as forty miles an hour. Whilst other animals have been reduced in numbers by hunters the giraffe has increased.

Hunting with African

Fierce Tribes of Warriors Who Fearlessly Fight Lions With Spears and Practice Free Love; Photographing Herds of Lions at Close Range; Giants Averaging Six Feet Three Inches and Pygmies Averaging Four Feet Seven Inches in Height. These and Other Thrilling Encounters are Vividly Described

IT seemed incredible when my investigations proved, upon my arrival in Mombasa, Kenya Colony, in September, 1928, that there never had been, according to all available records, a successful crossing of Central Equatorial Africa by motor car from one ocean to the other; that this challenge of the dark continent had remained unanswered through all these many years.

My expedition landed at the Port of Kilindini, September 7, 1928, and from then until the 26th was busy collecting equipment and supplies for the many months of hard work ahead.

On the 26th we drove to the ferry that was to carry us across to the mainland. From there my first objection was Moshi, which lies in the shadow of Africa's majestic mountain, the mighty Kilimanjaro, that towers 19,819 feet into the ever blue heavens of Tanganyika.

Many giraffes raced with us along the road, or stood at what they thought a safe distance and gazed in pop-eyed wonder as we passed. Herds of wildebeeste, kongoni, zebra and tommies kicked dust into our faces or stood at attention to see us by, while thousands of small animals and game birds were continually scattering away from the roaring trucks.

In the mountains that rimmed the horizon lived herds of elephants.

The African elephant, unlike his Indian namesake, has never been successfully trained for the use of men. Until recent years, ivory hunters penetrated the haunts of the elephant for centuries, killing millions of these majestic mammoths and taking away nothing but the tusks.

In the thorn thickets at the mountain bases the black rhinos browsed on the tender leaves or stood dozing in the shade.

During the night of our stay under shadow of Kilimanjaro we heard many lions about, while the leopards seemed to be all over the place and came close to the fire in order to have a good look at us. Their peculiar coughing got on my nerves for I have no liking for these savage little brutes and would much rather

Above — Twelve-year-old Masai toto, guardian of the tribe's cattle against lions.

Left—Male and female lion assume a vantage paint an top of an ant hill. Right — A Masai village, built of low huts and encircled by a hedge of thorn branches to keep out lions. Cattle are driven inside at night.

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Elephants in the Belgian Congo. Much of the world's supply of ivory comes from the Congo, where government restrictions are not so harsh as in other parts, and a great deal of poaching occurs. The Congo elephant has smaller tusks than the East African member of the family.

Giants and Pygmies

By Paul L. Hoefler

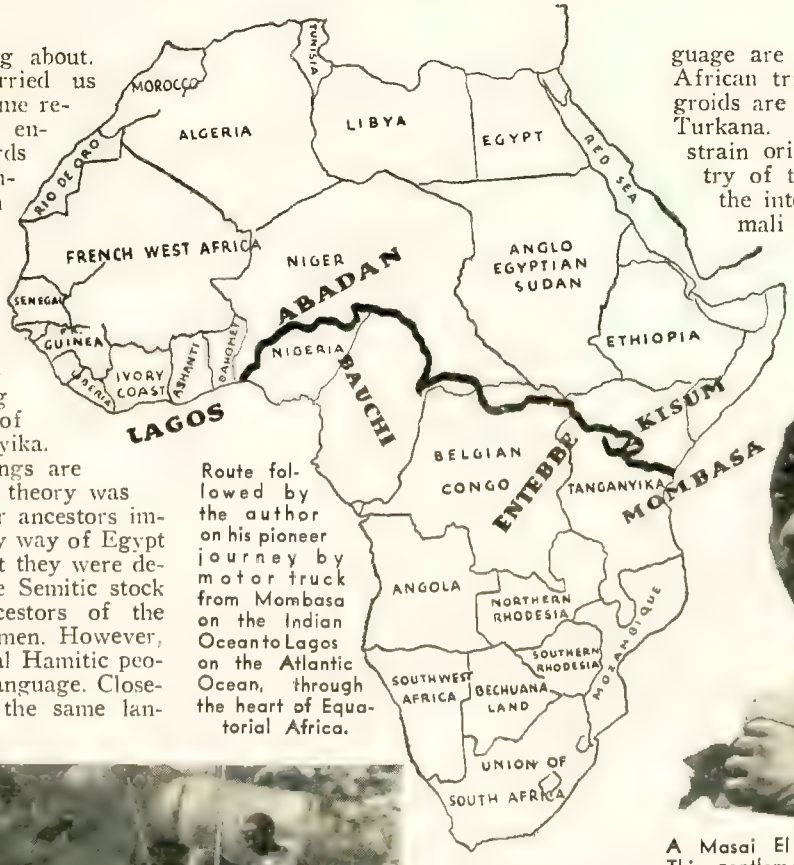
The author first went to Africa in 1925 with the Denver African Expedition, and again in 1928 as Leader of the Colorado African Expedition, during which he produced the talking film "Africa Speaks."

have the lions prowling about.

The fourth day carried us through the southern game reserve where we again encountered enormous herds of the common plains animals. We arrived in Nairobi after dark, and the next day commenced our final preparations for the trek into Tanganyika, land of the lion and Masai.

The Masai are a nomadic people, inhabiting the high-plateau steppes of Kenya and Tanganyika. Their historical beginnings are lost in the dim past. A theory was once put forth that their ancestors immigrated from Arabia by way of Egypt into tropical Africa; that they were descendants from the same Semitic stock of nomads as the ancestors of the Hebrew nation of herdsmen. However, they are a purely pastoral Hamitic people, speaking a Nilotic language. Closely allied and speaking the same language are the Samburu. Other East African tribes classed as Hamitic negroids are the Nandi, the Suk and the Turkana. It now appears that this strain originated in the steppe country of the Abyssinian highlands by the intermixture of Galla and Somali with Nilotic negroes.

The pure blooded Masai is considerably lighter in color than the negro; has clear-cut



Route followed by the author on his pioneer journey by motor truck from Mombasa on the Indian Ocean to Lagos on the Atlantic Ocean, through the heart of Equatorial Africa.

A canned concert in Tanganyika. There is no native music among the Masai, and like all savage men they go wild over jazz. Note the wire ornaments which load down the limbs of the ladies in the background. The two youths in right foreground are El Moran, or warriors.

A Masai El Moran, Tanganyika Territory. This gentleman of class was a collector of rare ornaments and this small milk can pleased him immensely.

features: well formed hands and feet and is of magnificent physique, seldom under six feet in height. The stalwart bronze-colored El Moran with his spear and shield is the very embodiment of physical courage and force. He is still the proudest of men, fearing no danger and looking down on all who are not as warlike as himself. Since time imme-

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Ngetuny Siiya (Lion's Claw), the young Nandi warrior who speared the first lion. Note claw scratches on shield and hole bitten by the lion.

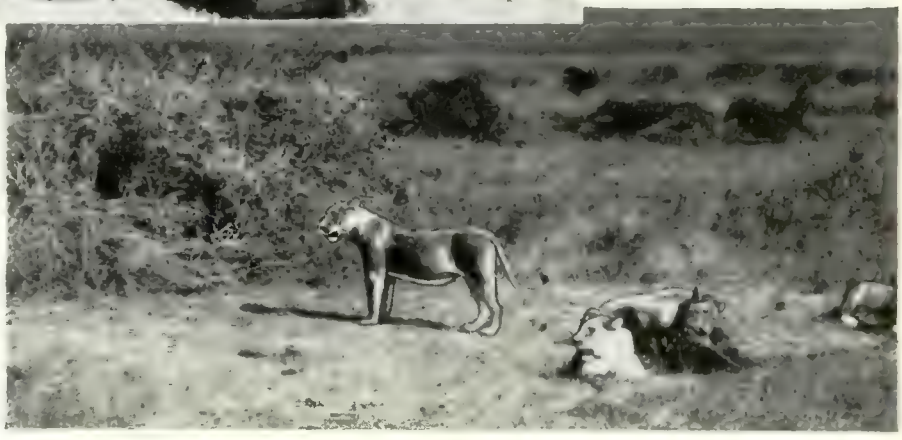
Right—The chief exhorts his warriors before the lion hunt, the theme being that their fathers had always hunted the lion fearlessly, that no Nandi feared his charge, for to do so was disgrace.

with their cattle—their only weapon being a short spear—and many times I have looked over the backs of lions to see in the distance one of the lone youths leaning against his spear, a sentinel silhouetted against the African sky.

All of their wealth is figured in terms of cattle. A man pays so many steers for a wife or is fined a number of head for some offense against tribal law. The herds supply them with practically everything needed in their Spartan-like life.

They milk the cattle and bleed the steers, these two fluids being mixed and allowed to curd. The resultant product constitutes their principal diet. It is an interesting fact that the Masai disdains all vegetable food, living on meat, blood and milk exclusively while members of surrounding tribes prefer a mixed diet.

Below—A view of one of the larger blinds from which pictures were secured of lions at close range. The lioness facing the blind is less than ten feet from the opening, which is quite big enough for her to jump through.



morial, the Masai El Moran, or warriors, have roamed over this vast steppe, keeping the other tribes in subjection and incidentally enriching their own cattle herds by raids, for these men made of cattle rustling a fine art.

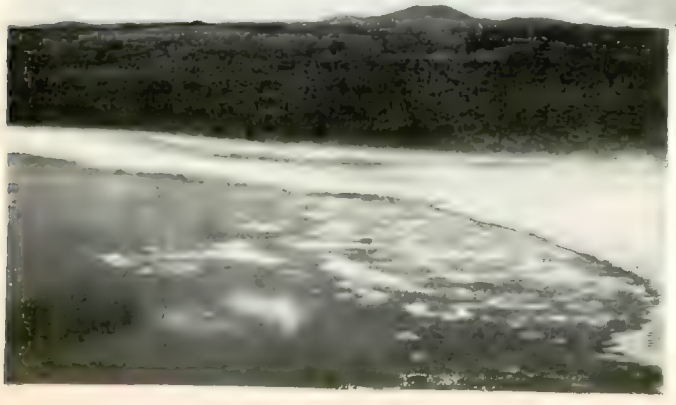
They still maintain tremendous herds of cattle, sheep and goats which they look after with greater care than for themselves. The animals are driven at night inside of a large circular wall of thorns eight feet high. Within this wall are the crude huts facing toward the center. The whole thing is called a manyatta or village. These enclosures are to protect their stock against the prowlers of the plains, and this is absolutely necessary, for the district is alive with lions and leopards, so that even with these precautions they lose many of their cattle to the big cats.

The cattle are attended by the youths of the village, who leave with their charges at dawn, feed them during the long hot days and return them to the thorn enclosed village before dark. In a country full of prowling Carnivora I have often come across these little boys (totos) all alone

When an animal dies they use the skin for clothing and the meat for food. The cow-dung is used as a building material; also for medicine, fuel and chairs. This material has the redeeming quality of being antiseptic, killing germs which would otherwise take full possession of the village where, of course, there are no sanitary arrangements.

The Masai are great believers in ornamentation, the women carrying around with them large quantities of copper and iron wire coiled about their arms, necks and legs. A fully outfitted Masai woman will have as much as thirty-five pounds of metal distributed over her body. The men also decorate themselves in a small degree, stretching their ears to enormous sizes, and one gentleman we met was a collector of rare ornaments, with a preference for small milk cans.

There is no native music among the Masai, but like all savage people they go wild over American jazz. We had a great deal of fun with our phonograph. They couldn't understand where the sounds were coming from and would gaze all about, looking for it. When we asked what they thought made it



Flamingoes on Lake Hannington. This remote lake is part of the chain of lakes that string down the Great Rift Valley. The water is heavy with soda, but must contain some life upon which its many millions of flamingoes, appearing as specks of white in the lower photo, feed. The birds are more numerous here than anywhere else on the globe.

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talk, their reply was that we had cut off somebody's head and put it in the box.

This tribe is undoubtedly dying out, due to changed conditions brought about by the white man's domination and also in no small measure to their own customs and the moral laxity of the last few decades. When tribal warfare and raids were almost continuous the El Moran had plenty to occupy his mind and time, but now that these outlets for his energy have been curtailed sexual excesses are bringing about a decadence of the race.

We tried our best to get the Masai El Moran to spear lions but nothing that we could promise interested them sufficiently to really get them organized and finally I found it necessary to fall back on what are, without doubt, the most expert of all African spearmen, the Nandi.

Previous to the arrival of the Nandi we had many experiences with lions during our filming operations on the plains of the Serengetti in Tanganyika. There is a widespread belief that lions live only in a jungle, though the truth is just the opposite. They are always found in open grassy plains, because the lion is a meat-eater and he feeds entirely on animals, which in turn live off the virgin grass of the open country.

Right — Lions take possession of the truck during the explorers' absence. They tore one of the spare tires from the rack and tried sharpening their teeth on it. Below — Paul Hoefler with a lion he brought down with a 220 grain Springfield bullet at 150 yards. Although about 1000 lions were seen, only five were killed.

Above—Riddled with spears, the lion lies vanquished while the victors pay him homage. Right—The Nandi spearmen bear the noble foe from the spot where he fell. It is part of their ceremony.

We had built several blinds around the country, most of them near our famous lion donga, from which we photographed the king of beasts as he lived his natural life in this great African wilderness. We were often within a few feet of a troop of lions, for all of the lion film was made with 50 m/m and 80 m/m lenses, some of the scenes filling the screen with a single animal. Several times we were charged by lionesses, whom we found to be more dangerous than the male and more uncertain in their dispositions. The bomas, of course, afforded a certain amount of protection, but this protection was not absolute and we were always in the position of a man pouring nitroglycerin; if anything was to happen, it would happen both suddenly and decisively.

On one occasion, having noticed that the lions were particularly interested in a certain blind, I took an old shirt of mine, which I stuck up on a small limb inside of the boma, leaving it overnight. The next day we found the shirt torn into a million shreds. This proved that the lions would come inside the boma, but why they didn't do this when we were inside I couldn't say. I am mighty glad, however, that they never took a notion to jump in and visit us.

In making pictures of wild lions at such close quarters you must of necessity take a few chances, but even this is different and less hazardous than standing in the open with a spear and shield and remaining steadfast while six hundred pounds of enraged lion dashes down upon you at the speed of an express train. This takes both courage and long training, and there are none who can compare with the Nandi spearmen in this most exciting of all outdoor sports.

We had taken the Nandi to a position between some lions and a donga with instructions to form a circle from there while we attempted to separate an old male from his troop. The

The photo below answers the question as to whether lions can climb trees. Given sufficient incentive, they can climb up small trees quicker than any man, but it is not possible for them to climb very high.

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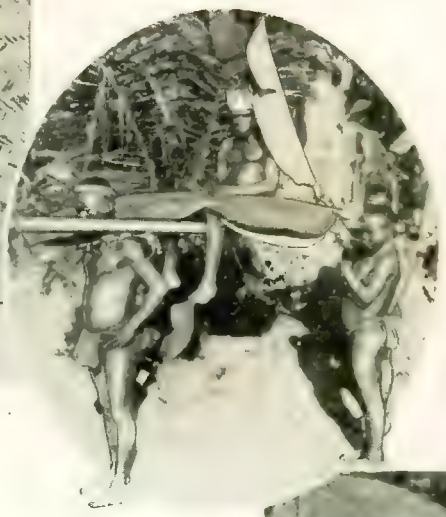
Left—Paul Hoefler at the entrance to the village of the Wasara, a tribe of giants living on the Sara River in the depths of the French Congo. Below—the sub-chief of the pygmy tribe being borne by two men while a young maid shades him with a banana leaf.



lions paid little attention to the motors, but upon the approach of the warriors on foot things began to happen and continued to happen for some time; so quickly, in fact, that it was like trying to watch a three-ring circus. My memory still pictures the barbaric and wild scene of spearmen rushing hither and yon; of the camera car being driven like mad over the veldt and every few yards hitting a big hole, which scattered parts of my equipment over the landscape. I had mighty little time to think about this then, for I was too busy holding on to the wildly careening truck. Somehow we managed to get into position, just as three Nandi were converging toward the crouching lion.

One slim Nandi youth walked slowly toward the enraged beast until within twenty-five paces, whereupon the lion gave a mighty roar and, springing as from a catapult, made straight for him. The warrior stood as rigid as a rock in the face of the lion's rush until the space had narrowed to a few feet; then he knelt behind the shield and raising the spear hurled it into the lion just before it leaped upon him. The tremendous impact of the charge threw the warrior to the ground, but he fell beneath the shield, at which the lion clawed and bit. Within a few seconds the other two Nandi were driving their spears into the maddened animal. Others rushing up did the same thing and shortly the lion resembled an overburdened pin cushion. He was dead and there was no mistake about it. The whole thing was over in thirty seconds—but what a thirty seconds! The man who took the charge received only a slight scratch on one leg as a result of the encounter. It was a wonderful display of courage and proved that the Nandi had not been over-rated in their prowess with the spear. Upon our return to Kapsabet, the Nandi gathered from many miles around to honor the returned spearmen, and there was a big dance and celebration for the victorious lion killers.

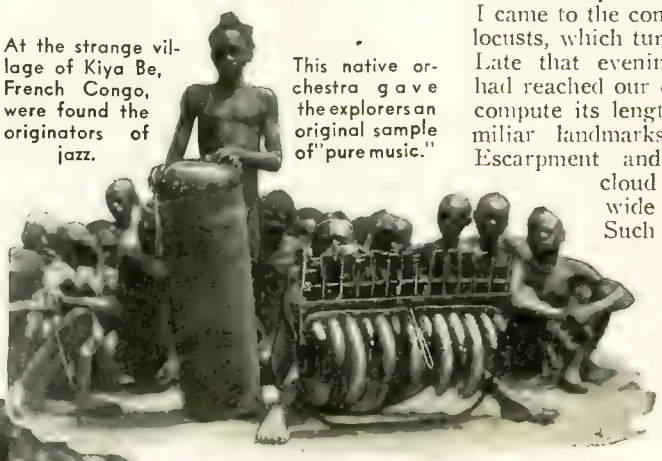
One of our most interesting safaris was that into the Great Rift Valley where after many hardships we were able to photograph the millions of flamingoes that live and die on Lake Hannington. I doubt if there is another place on the face of the globe so romantic and compelling as this remote region.

Here we filmed solid masses of pink birds covering many acres. It seemed that the smaller, but more brilliantly colored flamingo *Phoenicopterus minor* was more numerous than the larger species *Phoenicopterus roseus*, although this latter lived here in untold thousands. Surrounding the lakes in this tremendous valley we found immense herds of game: zebra, wildebeeste, kongoni, impalla, Thompson's and Grant's gazelles.

Lake Baringo was simply alive with hippopotami and for every hippopotamus there must have been a thousand crocodiles. It was while attempting to secure pictures of these reptiles early one afternoon that my boy called attention to what looked like a distant cloud of black smoke hanging over the far shore of Lake Baringo, where it curved over the earth's rim toward Abyssinia. In reply to my questions the N'jemps Kidogo, who are the native inhabitants of this region explained that it was a great mass of bugs. From their descriptions of former visitations, I came to the conclusion that they were locusts, which turned out to be the fact. Late that evening, before the swarm had reached our camp, we were able to compute its length and breadth by familiar landmarks along the Laikipia Escarpment and estimated that the cloud was about 50 miles wide and 150 miles long. Such swarms of locusts frequently fly several hundred miles in a day. A small part of this tremendous multitude of insects came to rest around our encampment, feeding all through the night so that when morning came we found the whole district absolutely devastated. This offered an opportunity for unusual film, and I abandoned the balance of my plans in the Baringo area in order to follow this swarm, finally filming most of our locust material near our old camp in Tanganyika.

Like an enor- (*Continued on page 74*)

This giant, a member of the Momvu tribe, has been adopted into the pygmy tribe of Ifi. He wields some influence with them and mixes the poison for their arrow points. Here is shown the ceremony of poisoning new arrows.



At the strange village of Kiya Be, French Congo, were found the originators of jazz.

This native orchestra gave the explorers an original sample of "pure music."

The disc women of Kiya Be, French Congo. Some wear one disc and some have two, the larger ones, denoting high social status, measuring as much as eight or ten inches across. The origin of this custom is explained in the text.

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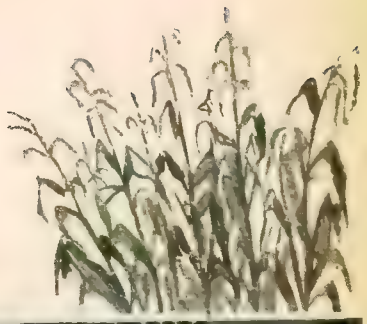
Lifting the Ban on Corn Sugar



By John L. Coontz

THE ban has been lifted, the barriers removed, prejudices swept away, and now corn sugar, through a recent ruling of Secretary Hyde of the Department of Agriculture can be used as extensively as individual tastes dictate, in the production of the prepared foods which appear on the American market.

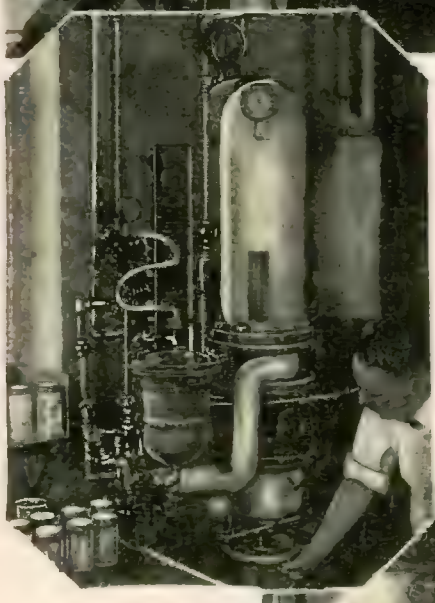
Prior to the removal of the discrimination against corn sugar it was required, as a matter of administrative interpretation of the pure food law by officials of the department, that the presence of corn sugar in prepared foods be so declared on the labels. Now, this being no longer required, virtually a new sugar comes on the market. Where once corn sugar had to be specified as an ingredient in prepared foods it does not now have to suffer that discrimination. It meets, therefore, today, other sugars on common ground.

What, then, is this new sugar come before the American public—new because of this newly pegged standing in the field of accepted standard sugars? How is it produced? How does it compare with cane and beet sugar as a sweet? What uses is it being put to today and what probable new uses will it be put to as a result of the removal of the discrimination against it in competition with other sugars?

Sugar, as we commonly know it (cane or beet), is the product chemically defined as sucrose. Its chief source is sugar cane, sorghum, sugar beets, maple trees and palms.

Corn sugar, on the other hand, is a "starch sugar," or dextrose, the product of corn starch, in turn the product of the corn grain. This starch is obtained by separation of it from the other constituents of corn grain through suspension in water. In this form it is known as "starch milk." "Starch milk" thus defines the starting point in making corn sugar. It is made in the following manner:

Many of the better types of candy contain corn sugar. Here we see a corner of a candy laboratory where exhaustive tests are made to determine the purity of every candy ingredient.



Part of the apparatus used to test candy products.

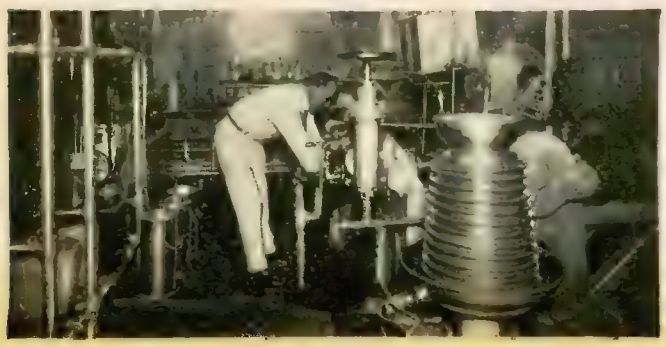
The "starch milk," or more conveniently for our purpose, milk of starch, is placed in great lead-lined steel containers called "converters." These converters hold from two to four tons of starch each. In them the milk starch, to which has been added commercial hydrochloric acid in the proportion of about 200 pounds of acid to 5,000 pounds of starch, is boiled. This boiling is continued under live steam until the thick gelatinous starch mass breaks down under the action of the acid into simpler forms of carbohydrates, etc.

From the huge converters now the starch, in liquid form, goes into closed copper cookers, where, under about 40 pounds of steam pressure (around 285 degrees F.), a quicker and more complete conversion of its constituent parts into dextrose or corn sugar takes place. While the starch is in these cookers it is tested from time to time to see if the conversion has been thorough.

In the home, corn sugar can be used for preserving fruits and vegetables.

After the conversion it becomes necessary to neutralize the free acid in the starch liquor. This is accomplished by running the liquor into large wooden tanks, adding soda ash to it, and agitating the whole. This serves to clarify the liquor, causing the albuminoids and fatty substances in the mixture, to gather like butter for removal. This removal is accomplished by running the liquor through filter-presses.

The starch (*Continued on page* 89)



The velvety appearance which corn sugar imparts to ice cream makes it a desirable constituent. View of a typical factory testing room.

A recent portrait of Vincent Raschella.

An Aviation Pioneer Historians Never Knew

The Following Is the First Account Ever Published of the Pioneer Aviation Experiments of Vincent Raschella, During the Period 1886-1895. These Experiments Covered Both Heavier- and Lighter-Than-Air Machines

IN the course of a year many varied and interesting personalities visit the editorial offices of a magazine such as SCIENCE AND INVENTION. One day recently we received a visit from an elderly man, slightly under medium height, inconspicuously dressed, yet possessed of a faint air of past distinction in his facial appearance and bearing.

Speaking English with a decidedly foreign accent, this man produced from under his arm a bulky envelope of documents which he proceeded to lay before Ye Editorial Staffe and explain. Ancient drawings, dilapidated letters, and dog-eared sheets of yellowing foolscap soon covered a desk.

The tale he had to tell was full of romance, thrills and human as well as scientific interest and, apparently, historical value. Here was one of the pioneers of aviation, long forgotten, unheralded and unrecognized. In 1886, he told us, he made his first flight in a glider. In 1889 he made his first flight in a cigar-shaped balloon, inflated with hot air, fitted also with wings, and driven by foot power. Was he the first man to design, build and fly a navigable aircraft, or at least a heavier-cum-lighter-than-air combination? He did not know. He made no wild or boastful claims. He simply presented the facts, backed up by incontrovertible evidence. He merely wished to make public the salient points of his achievements which, so far as he knew, had never been conceived by anybody else.

The name of our visitor was Vincent Raschella, at present living at Weehawken, N. J., and his story is perhaps best told in his own words.

"I was born at Caulonia, Province of Reggio Calabria, in the south of Italy, on September 25, 1863, so I am now in my 68th year. While yet in my teens, by some natural instinct all my toys invariably had something to do with aeronautics. Kites, paper balloons, drawings of bugs and butterflies in all sorts of crazy shapes were my exclusive amusement.

"Meanwhile, I took up art, but as I was born in a part of Italy where I could not cultivate my vocation, I went to Rome to study. In my spare time I studied also the work of those who contributed so much to aeronautics, from the fable of Daedalus to Archytos, down through the long list—Leonardo da Vinci, Cardani, Lana, Montgolfier, Pilatre, Rozier, Nadar, etc., and I learned enough to become more deeply interested.

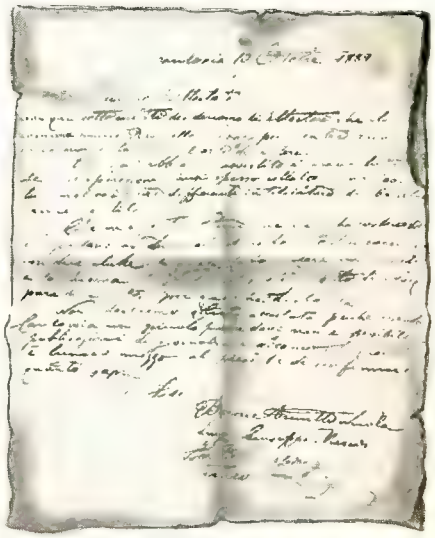
"In 1886 I built my first glider. It was an oblong frame of canvas and bamboo, measuring about twelve by six feet. From the center there dangled a trapeze from which I hung on with my hands while I managed to throw the whole apparatus above my head. On my first trial I jumped from the top of a cliff. I did not fly far, just described a downward trajectory and landed on my feet with little gain in distance. On the second trial the landing was not so good, the frame broke, and I sprained my left foot.

"Later on I built a second glider, similar to the first, but I did not have any better results.

"After a number of unsuccessful attempts with these two types of glider, I realized the impossibility of flying with them, and although I had confidence in the principle, I sought further means of buoyance, in conjunction with a propelling power.

"With this in mind I later on built another glider, but this time I attached above it a cigar-shaped balloon made of a sort of cheese cloth lined with tissue paper. I treated the cloth with a solution of calcium chloride, sulphate of iron and alum to make it incombustible. The balloon was sharp pointed at both ends and measured about 43 feet long, 12 feet high and 9 feet wide.

"It was equipped with a seat, wings



Above—Facsimile of a public affidavit, dated October 10, 1889, which authenticates Mr. Raschella's claims. A translation is given in the text. Left — Reproduction of Vincent Raschella's original drawings of the Ital-ereo, the dirigible airship for the construction of which he could get no support because no suitable motor was available.

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The Editors of SCIENCE AND INVENTION Have Carefully Examined the Documents Submitted by Mr. Raschella in Support of His Claims, and Have Satisfied Themselves Completely as to Their Authenticity. Like Many Another Inventor, Mr. Raschella Was Forced to Abandon His Experiments on Account of Lack of Financial Support

similar in form to those of a bat, two pedals, crank, pulleys and two propellers to be driven by foot power (see Fig. 1 for original drawings). The wings did not flap but they were susceptible to adjustment by warping, thus emulating the ailerons of a modern airplane. The frames were of bamboo and canvas, the

L'ITALIA MILITARE E MARINA

La viabilità aerea. Sappiamo che al Ministero della guerra è stato presentato dal signor Vincenzo Raschellà un progetto per un aerostato dirigibile, il quale sembra non sia una delle solite utopie di sedicenti inventori. Se così è, l'arduo problema della viabilità aerea sarebbe stato finalmente risolto.

Ci viene assicurato che la invenzione del signor Raschellà ha prodotto ottima impressione in coloro che hanno preso in esame il progetto, e che, fra sette od otto mesi, compiuti gli esperimenti necessari, potrà compiersi il primo viaggio aereo, adoprando il motore trovato dal giovane inventore calabrese, non ignoto per i suoi studi [illegible] nostro parco aerostatico.

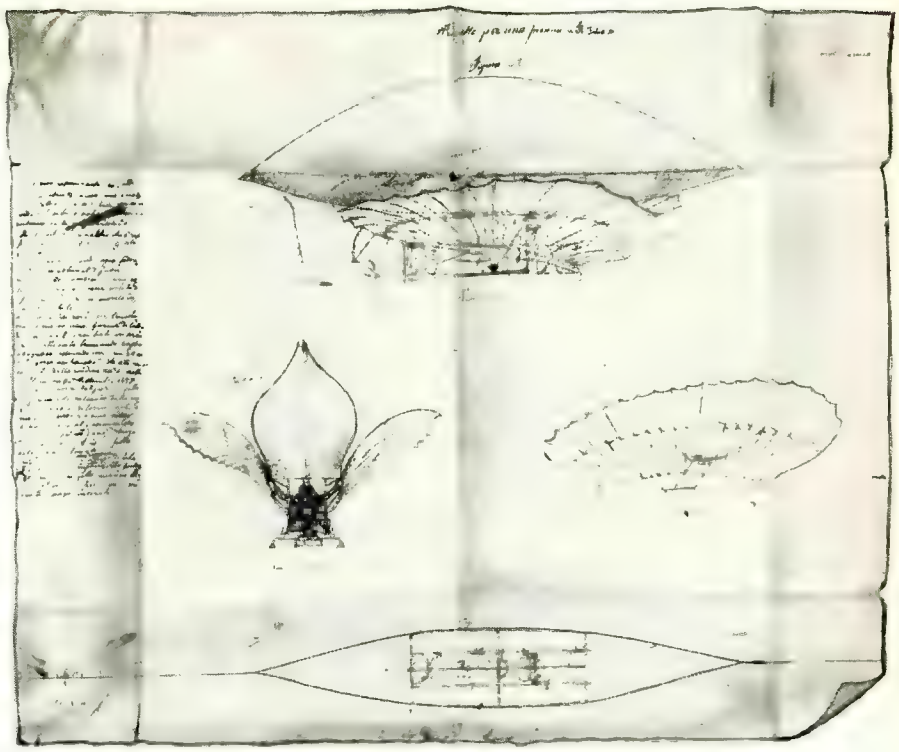
pulleys of wood, and for ropes I used twine which I waxed. To inflate the balloon I used hot air, produced by burning moist straw.

"On September 25, 1889, my 26th. birthday, I made my first flight in this machine, starting from the top of my usual cliff. The flight was entirely successful, for I covered a distance of about 200 yards and landed near a large apricot tree. I could have flown further, but my place of experiments was a hill on my father's farm (called Serongi), and the terrain around sloped so that the vicinity of the apricot tree was the only flat spot on which I could land.

"I made several flights thereafter, some very successful. No, I cannot tell you at what speed I flew, nor my greatest distance. Owing to the restricted space available, my only way of carrying out an endurance flight was to cruise round and round in a small circle, and in this way I stayed in the air as long as forty minutes.

"I named this apparatus the 'Falcon.' About the end of October of the same year, during one of my flights, one side of the bag burst, emitting the hot air, and the whole apparatus crumpled and came down to earth.

"Soon after that I built another good-



Above—The original drawings of The Falcon, the heavier-cum-lighter-than-air dirigible, driven by foot power, which Mr. Raschella designed, constructed and flew successfully in 1889. A detailed description is given in the text. Left—Facsimile reproduction of a report published in a Roman newspaper dated January 22, 1895, recording Mr. Raschella's efforts to interest the Italian War Ministry in the Ital-ereo. Translation given in text.

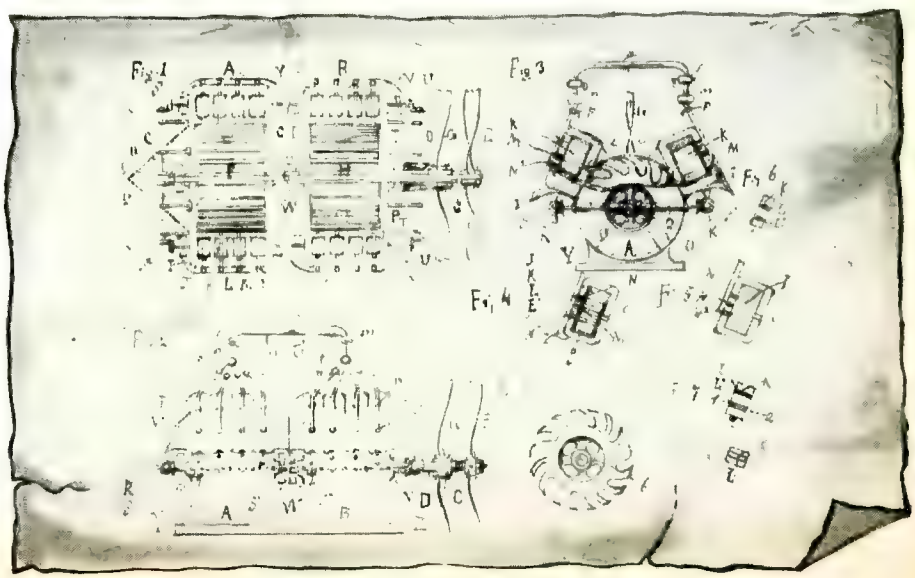
size model, all of tracing cloth, the shape of a large winged butterfly. The body was cigar-shaped, and the wings were double cloth covered. Both the body and the wings were to be filled with hydrogen gas, so that the lifting power of the gas would equalize the weight of the structure. Thus, with its wing spread, it would glide in the air in a manner similar to a modern monoplane. However, as aerial motors were not known in those days I turned my attention to the natural gift of flying birds. I killed pigeons, bats, swallows and butterflies, to study especially the construction of their wings.

"I watched the steadiness of some birds while flying, their straight course, evolutions, change of height, etc., without a single flap of their wings. In this way I tried to imitate Nature, utilizing the different currents of the wind.

"In 1893 an idea of a motor came to me in a sort of turbine driven by the force of an explosive. I drew plans (see below), but at this time I will not say much about it as the whole idea remained in embryo. No doubt, today, with present progress, it ought to be entirely redrawn. I simply will say that the drawings call for a duplex motor,

(*Continued on page 66*)

The original plans for a duplex turbine driven by an explosive, which was to power the Ital-ereo. Lack of money prevented the construction of this motor and this, in turn, led to the rejection of Raschella's entire plans and his abandonment of further experiments.



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Margaret Roller, "food sculptress" for the U. S. Department of Agriculture, probably has the most novel job in the world. She models entire meals made of wax for government exhibits.

Probably one of the strangest jobs in the world belongs to this scientist. He acts as guardian to this "smoking machine," devised to study the burning qualities of cigars.

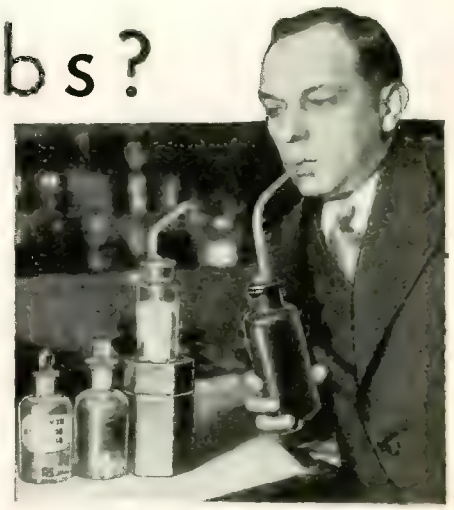
Don't They Have the Queerest Jobs?

By James Nevin Miller

ALL day long, in a remote Washington laboratory, a sturdy-looking man works at one of the strangest jobs in the world. Box after box of cigars he opens—five cent ones, two-for-a-quarter weeds, besides fragrant affairs that only the very rich man could afford to buy. And yet, Mr. D. E. Brown, who breathes the scent of probably hundreds of thousands of cigars a year, smokes nary a one. Instead, he painstakingly unwraps each package of nicotine, inserts cigars into a queer-looking contraption that holds just four of them, and then sets a match to each one. But there's an excellent reason for all these apparently fantastic maneuvers. For Mr. Brown is a scientist with the Tobacco Investigations Division of the U. S. Bureau of Plant Industry.

Above—Here's a queer-looking instrument, designed by Dr. C. F. Marvin, chief of the U. S. Weather Bureau. It is called a clinometer, and is used at airports to determine the height of clouds at night.

Left—No, this isn't a rat circus, but a corner of a government laboratory where an expert tries out on white rats the effect of certain poisons found in meats.



You probably won't envy this Post Office expert, whose job is to try out all kinds of freak contraptions sent through the mails and see whether they are fakes or not. Here he's shown making a long face because he's investigating a new type of patent medicine.

And his very serious purpose is to study the burning qualities of cigars, including the uniformity and evenness of the burn, the firmness and color of the ash, the relative rate of burning of the wrapper, burner and filler.

This able guardian of what is believed to be the only "automatic smoker" in the world, is only one of a vast army of distinguished "odd-job" scientists of Uncle Sam, whose daily occupations to you and me seem novel, to say the least. Yet every one is of great importance in the government's widespread efforts to improve our health, wealth and happiness.

For instance, some of these scientists use a "vacuum cleaner" on a cow's back; another studies the strange antics of "daylight saving birds"; still another acts as a "food sculptress," devising luscious look- (*Continued on page 71*)

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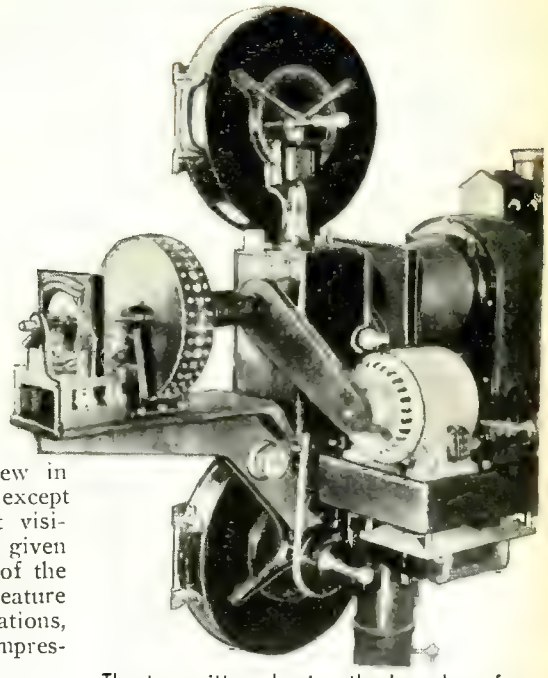
London Looks in at New Television Departure

By W. G. W. Mitchell, B.Sc.
Secretary, Television Society, London, England



The transmitter, showing the lens drum from which the pictures are projected. At left of lens drum is the generator which supplies the synchronizing signals.

ONE of the obstacles in the way of the further progress of television by existing mechanical methods is the difficulty of increasing the detail and scope of the images without increasing unduly the physical dimensions of the apparatus. Another difficulty lies in the fact that as the amount of detail is increased, so the frequency of the picture impulses increases, and as the frequency is increased so the difficulties in the way of transmitting the wide frequency bands, either by wire or by radio, increase.

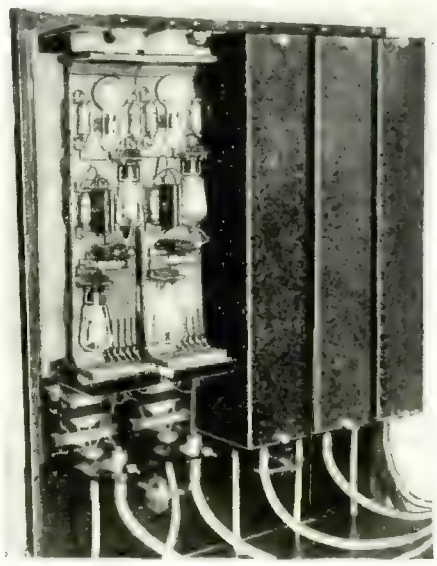
It was suggested some time ago that these obstacles might be overcome by dividing up the picture into several sections, or zones, scanning each zone separately and transmitting the image signals from each zone over a separate communication channel, and recombining the zones in proper sequence at the receiver to form a true reproduction of the original picture.

Such a system has recently been experimented with by the Bell Telephone Laboratories, who used three zones and wire channels of communication.

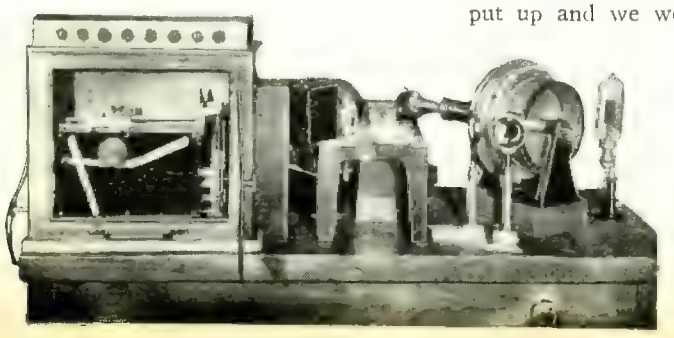
Until the time of the demonstration which forms the subject of this article, the only commercial concern in England to seriously interest itself in television was the Baird Company, formed to exploit the inventions of John L. Baird. Early in January of this year, however, the H. M. V. Gramophone Company ("His Master's Voice," the English relative of the Victor Talking Machine Company) entered into competition by giving a demonstration of five-zone television at the Physical and Optical Societies' Twenty-first Annual Exhibition at the Imperial College of Science, South Kensington, London.

Apart from the multiple zone feature, it may be said quite definitely that there was nothing essentially new in this demonstration of television except for one fact, and that was that visitors to the demonstration were given free access to the working parts of the apparatus. This is quite a new feature in English television demonstrations, and one which made a great impression on me.

After waiting an hour or more in a long queue, visitors were taken in batches of twenty or so and given a demonstration in a semi-darkened room. Accompanying the demonstration was a talk on the subject, presumably from a record, explaining the system in use. The demonstration itself lasted some 15 minutes, after which the lights were put up and we were at liberty to inspect the actual apparatus and ask questions of those in attendance.



The five photoelectric cell amplifiers, one for each zone of the picture. From each amplifier the signals are fed to the receiver through the armored cables at the bottom.



The new televisor. At left, the projection lantern. Centre, the five Kerr Cells. Right, the mirror drum from which the light beams are reflected and focused on to the screen by means of the lens in the foreground.

In fairness to the Gramophone Company, it should be stated that the demonstration was presented to the public (or the scientific section of the public which visits the annual exhibitions of the Physical and Optical Societies) as an advanced laboratory experiment. It was quite definitely stated during the course of the demonstration that the company had no intention of exploiting the system commercially at the present time. Further, they stated that no system *can be* commercially successful unless it will give a form of television possessing definite entertainment. Accordingly, the research engineers of the company have concentrated on two points: (1) The employment of a large number of picture elements to each unit area of the picture to get good definition, or detail, and (2) discarding the neon glow discharge lamp in favor of the Kerr Cell for modulating the powerful arc light needed to give an image of real entertainment value.

Movie films, depicting outdoor scenes of London, were used for the demonstration. The film was scanned at the transmitter in five sections or zones of thirty lines each, a lens drum being used to traverse a succession of images over five scanning apertures. The picture was thus built up of 150 scanning lines and may be considered as composed of some 15,000 picture elements. The extreme frequency required in each channel to produce this detail, scanning at 12½ pictures per second, is approximately 23,000 cycles per second. From observation of the received picture, which measured about 24 inches wide by 20 inches high, the amplifiers seemed quite capable of dealing with this frequency band.

There were several very noticeable defects: (1) The (*Cont'd on page 78*)

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Count Felix von Luckner in his lifeboat, which is powered with an outboard motor.

A pair of outboard motors propelled Mr. George Fisher's sailing yacht from New York City to Buffalo via the Hudson River and the Barge Canal.

The Versatile

Strange and Wondrous Are the Fields Into Which the Outboard Motor Has Penetrated . . . Aside From Propelling Boats of All Kinds, It Has Been Used as the Engine of an Airplane.

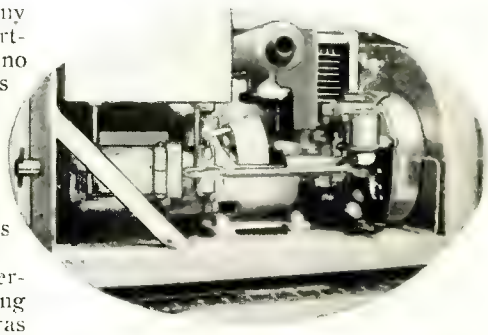
By Dick

NOWADAYS the mere mention of "outboard motor" immediately suggests dancing, galloping, frolicking speed over the water. Rightly it should! Outboard motors have turned in some sensational speed records. So fast have the figures soared upward that the record of today is passé tomorrow. Little outboard boats are flirting with 50 miles an hour now, and it is almost safe to predict that before this appears in print, the "mile a minute" mark will be posted on the official bulletins.

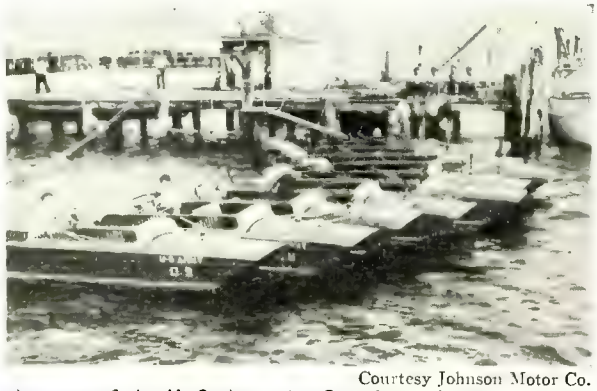
Speed! Speed! Speed! Speed may appear to overshadow everything else in the outboard field. There is a joyous exuberance and a thrilling exhilaration in skipping over the water at 40 miles an hour. The primary purpose of the little motors is to provide pleasure. But, even as they have won blue ribbons at racing carnivals, so they have brought credit upon themselves in other fields, too.

While the outboard motor was originally intended solely for boat propulsion, the completeness and compactness of its power-plant, lends this unit to many other uses where light, compact, portable power is required. In fact, no stock-model, portable power-plant has ever been offered on the market that is comparable to the outboard motor power-head in compactness, symmetry, and available power. So it is little wonder that these little power units have been applied to many uses other than boat propulsion.

In South America outboard power-heads are used extensively for spraying insect powder. In the High Sierras they provide water to mining camps. Fish hatcheries use them for aerating the water of frozen ponds. Forest ranger stations always have an outboard driven water pump at hand with which to fight forest fires. They drive portable radio sending sets; cyclecars; suction pumps; blowers. A Bellingham, Wash., man has actually flown an airplane with an outboard motor. In Racine, Wisconsin, an ambitious and enterprising "home work-shop fan" drives his machinery with an outboard motor. Outboard motor ferries and water taxis can be found the world over.



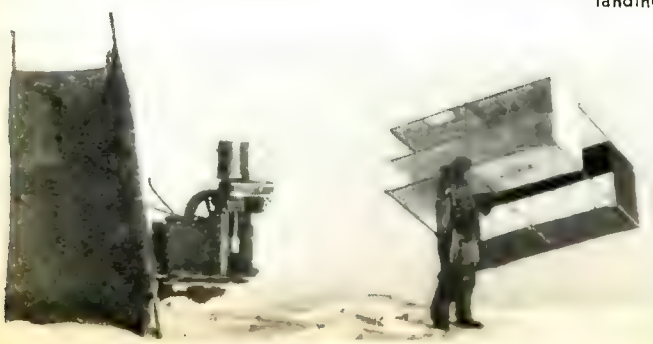
This compact outboard-powered radio-sending set kept Commander Byrd's party in constant communication with the outside world.



Courtesy Johnson Motor Co.

A group of the U. S. Army Air Corps' speedy rescue boats, equipped with outboard motors and three-blade propellers. They are being utilized to lessen the hazards of emergency landings of planes.

But, even as these little motors have brought credit upon themselves in other fields than boating, they merit Carnegie medals for conspicuous rescue work. An outstanding example of this was during the great Mississippi flood several years ago. In Elba, Alabama, the murky waters swept through the town when a dike broke. Food, clothing, bedding were washed away. Wires were down—communication with the outside world was completely cut off. The surviving inhabitants gathered on a little half-acre mound which rose above the water of the flood, and fearfully watched the rising waters make



Cyclone Haines, of the Byrd Expedition, holding one of the box kites used by the Meteorological Survey Department. The outboard motor to the left was the kite winch, and did service satisfactorily when the weather was thirty degrees below zero.

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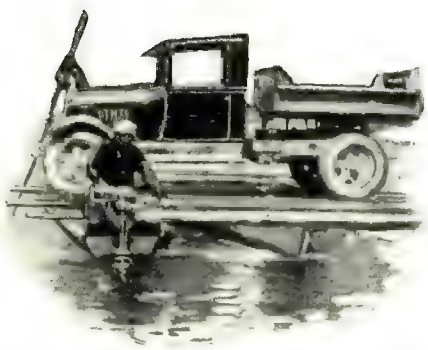
Courtesy Elto Motors

Even Venice has gone outboard. The motor-powered gondola taxi.

Outboard Motor

Outboard Motors Have Functioned for Elevating Water for Irrigation, as Portable Suction Pipes, for Driving a Centrifugal Pump, for Byrd's Electric Generating Set, and for Powering an Improvised Ferry!

Cole



An outboard motor that propelled three canoes functioned for a month as an improvised ferry over the Queets River, near Clearwater, Washington.

Vern C. Gordt of Seattle, safeguards his seaplane in case of a forced landing by including a small outboard in his equipment.

their haven smaller and smaller. Cold, wet, and hungry they waited and prayed for aid. One scow-like boat was at hand, but it would have been suicide to have ventured forth on the swirling, turbulent flood water with only a pole for propulsion.

Filled with anxiety and terror, the marooned people waited—waited. A speck appeared on the horizon. It grew larger. The drone of a motor was heard. An airplane to the rescue! But it was not fitted with pontoons: only with wheels. It could not land. Hopes of early rescue faded.

It swooped low. Bundles were thrown out. Food and blankets! The plane zoomed by. Then circled back. A big, bulky object tumbled from the fuselage, and fell into the muddy water close to the remnant of land. It was hauled ashore. A bale of cotton! A bale of cotton for Alabamans! Like bringing a refrigerator to the Eskimos. Surely there must be some reason. It was no time for practical jokes. The bale was ripped open. Carefully packed to safeguard it from injury was a sturdy outboard motor. Literally a life-saver. Quickly it was attached to the heavy scow and carried the marooned party out of the flood zone.

The United States government officially recognized the outboard as necessary equipment for airports, in case of emergency landings, where a fast rescue boat is needed.

When a plane strikes the water at about sixty miles per hour, the shock of its landing may stun the pilot, and the force of the impact thrust the cockpit under water. The average plane seldom floats more than thirty minutes; heavy bombers and pursuit planes remain afloat an even shorter time. So twelve landing fields have been assigned outboard motor rescue boats, which have maintained speeds of from 22 to 25 miles per hour in service.

The outboard motor found another advocate in Count von Luckner, the noted German sea raider. Last Spring he took a party of fifty boys for a 6,000 mile cruise of the Caribbean Islands. All his lifeboats were equipped with outboard motors and functioned very well. In addition, the boats were in constant use for transporting the boys from ship to shore, whenever they stopped at a port. They were often used for fishing; the motors being thoroughly tested in the shallows. They proved themselves capable of carrying 45 passengers.

Outboards showed just what they could do again when the Count accompanied his boys on a twelve mile cruise along the coast of the Martinique from St. Pierre to visit Mount Pelee, an active volcano. Some of the party went by auto over a winding trail, and made the trip in two hours and fifteen minutes. Von Luckner and several of the boys elected to go by water, utilizing their life boats. They arrived in two hours.

Hats off to the outboard!

This mosquito plane, weighing only 300 pounds, is powered with a 32 H. P. outboard motor head. It flies beautifully.

The outboard motor, designed primarily for thrill-seeking sportsmen, can also be used to great advantage by level-headed construction engineers.

The latest equipment for a contractor or bargeman is this portable suction pipe, whose power head is an outboard motor.

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Watching The Earth Rotate

SCIENCE AND INVENTION Makes Some Experiments With a Foucault Pendulum

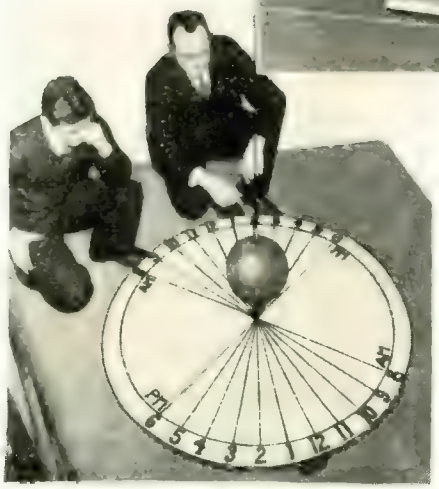
Members of SCIENCE AND INVENTION Editorial Staff with Colonel Wm. J. Costigan (standing second from the left) experimenting in the armory of the 165th Regiment. This experiment is described in the text.

DOES the earth rotate?

Most people would meet such a question with the utmost derision. Everybody, you would be told, knows full well that the earth not only rotates around the sun, but also around its own axis. But how to prove that the earth rotates around its own axis? Strange as it may seem, there are still people in this world, and not uncivilized savages, either, who refuse to believe it. And yet the theory is susceptible of easy proof by means of a simple pendulum.

If a heavy weight be suspended by means of a wire from a high fixed point, and the weight be set swinging in a single fixed plane, it will be observed that the weight repeatedly follows a given line across the ground or floor under it. After the pendulum has been swinging for some minutes, however, it will be noticed that the line produced by the weight appears to be shifting, slowly but steadily, just as if somebody had grasped the imaginary line by its centre and was slowly twisting it around.

"To simplify our visualization of what is occurring," writes Dr. Donald H. Menzel, our Astro-Physics Editor, "let us imagine that the pendulum is hung in a room directly over the North Pole, as shown in Figs. 1 and 2. For the sake of reference, mark a point A,



Prof. John A. Eldridge demonstrating the Foucault pendulum to a student of the University of Iowa. This pendulum hangs from the top of a 100-foot shaft, and weighs 100 pounds.

from which the initial swing of the pendulum started. Then, as the earth rotates on its axis, the point A will no longer remain beneath the pendulum. In twelve hours it will have moved to point B, the opposite edge of the swing, and in twenty-four hours (assuming the pendulum keeps on swinging for that length of time), the point A will have made a complete revolution and be back again at the starting point.

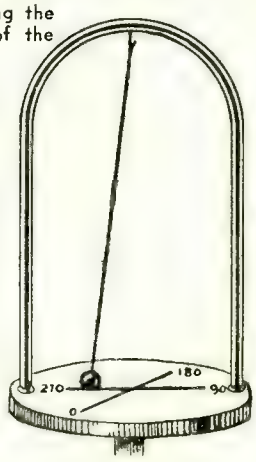


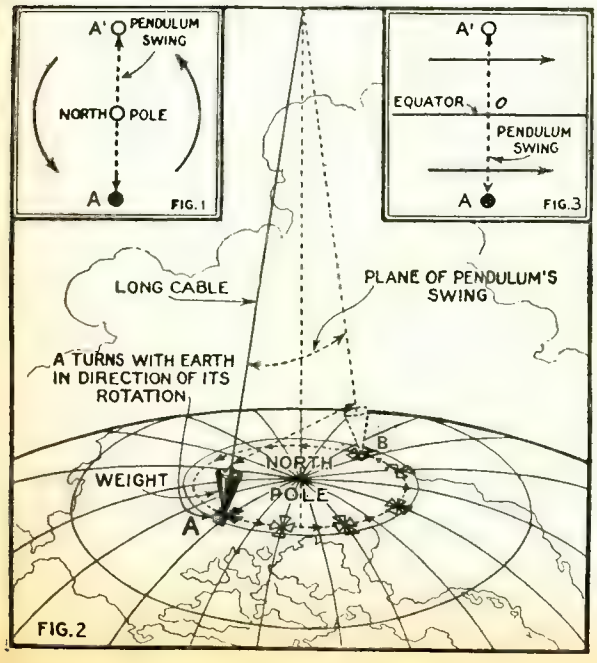
Fig. 4—This simple rotatable device can be used to demonstrate easily and clearly the principle of the Foucault pendulum.

"It is, of course, the plane of the pendulum's swing that is truly stationary in space, due to the inertia of the weight, while the earth is turning. But to us who live on it, the earth appears stationary, causing the direction of the swing to seem to rotate slowly, like the hands of a clock. At the Equator the plane of the swing of the pendulum will not rotate, since there is no tendency for the floor of the room to turn around (Fig. 3). At intermediate latitudes, the floor tends to "skew" around beneath the weight, the time taken by the plane of oscillation of the pendulum to make its complete circle, depending upon the distance of the place from the Equator. In latitude 41° N. the rotation is about 240° per day.

"This pendulum test, providing the first definite proof that the earth does rotate about its own axis, was first performed in 1851 by the French physicist, Foucault, under the dome of the Pantheon, Paris. To this day the experiment is still referred to as the Foucault Pendulum. There are several such pendulums permanently set up in various parts of the world. In South Kensington Museum, in London, one is maintained for public exhibition."

The construction and operation of a Foucault pendulum has to be carried out very accurately in order to insure complete success. The first requisite is a firm, lofty point of suspension, twenty feet or over in height. The higher the point of suspension, the longer will the pendulum swing. The pendulum weight should be a cannon ball at least twelve pounds in weight. Within reason, the heavier it is the better. The ball should be floated on mercury and the uppermost point marked first with chalk and then with a centre punch. With a vessel of the proper shape, very little mercury is required. The ball must then be centred in a lathe on the spot marked and turned accurately. A hole is then drilled at the spot marked, into which is screwed the suspension hook to which the wire is attached. Diametrically opposite to this hole another hole is drilled, into which is inserted a short length of rod which is then turned so that it tapers to a point.

The ball is now ready for suspension by means of a steel piano wire sufficiently strong (*Continued on page* 86)



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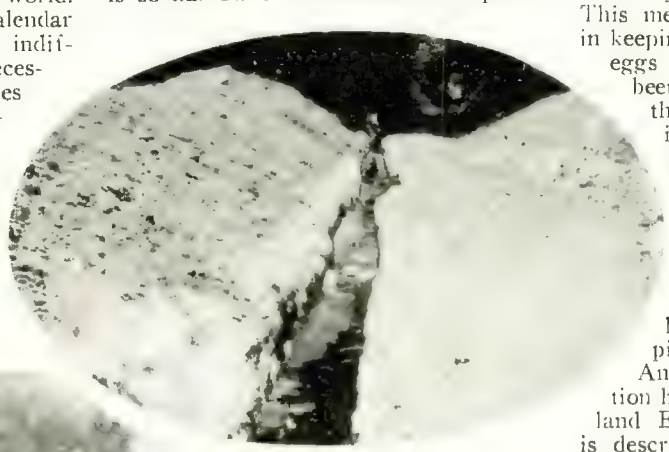
Beating the Fly to His Wings

A Fundamental Principle for Maintaining Control of Flies on a Large Scale by Attacking the Insect in the Transition Period Between the Active Larval Stage and the Mature Fly

By David Arthur Brodie*

At this stage the fly is hard to kill. Destroy him in the larval stage when he is helpless.

FROM time immemorial the human race has been fighting flies in the winged stage. Fly traps and poisons furnished with tempting baits have been laid in their paths to lure them to their doom. Gummed papers have been used to hang from the ceiling, or spread about the home on tables, chairs, and shelves. "Knock 'em cold" sprays have been advertised everywhere and used widely. Electrified screens and other devices have been invented, and "swat the fly" slogans have reverberated around the world. Everything in the fly-control calendar has been tried with more or less indifferent results. But useful and necessary as these combative measures are in affording temporary relief from an existing evil, they do not strike at the root of the trouble. Great epidemics are not stamped out by curing those already sick. The cause must be found and remedial measures applied at the source. So it is with the fly menace.



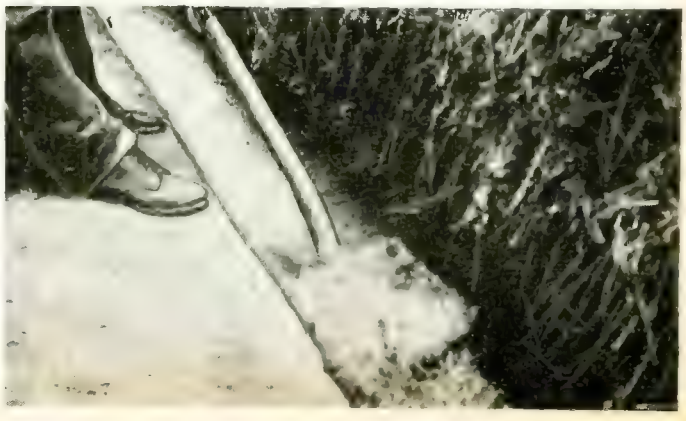
Although this trench has been just completed the surface of the oil is already covered by larvae.

The dead larvae can be removed by the shovelful.

This does not mean, however, that intelligent attempts have not been made to suppress the fly in the earlier stages of his growth, particularly in the egg and larva (maggot) stage. Many cases are on record where local success has been attained in this direction. For example, it is known that in some of the army camps where large numbers of horses and mules are kept, flies have been held in check very effectively by treating all manure with borax, crude oil, and other materials that have been found effective in repelling flies or preventing fly breeding. The trouble with this form of treatment is that most chemicals that will kill fly eggs and larvae have a detrimental effect on the fertilizing qualities of the refuse. This is especially true where the actual work of applying the stuff must of necessity be left to unskilled labor, because, as in the use of borax, the margin of safety between the amount necessary to kill larvae and that which will injure crops is so narrow that it is almost impossible to determine it except under laboratory conditions. Obviously, where crop production is of prime importance, any method that calls for the treatment of farm manure with questionable materials is not likely to become popular.

In addition, it is reported that in certain parts of Europe manure is built up in compact heaps and covered all over with soil. In some instances, oats, or other quick-germinating seed is sown over the earth covering to prevent flies from laying their eggs in the manure. This method is fairly successful both in keeping the flies away and in killing eggs and maggots that may have been in the manure before it left the barns. In the latter case, it is believed that the heat of fermentation generated in the pile is held in by the soil cover and intensified to such a degree that few larvae escape. The chief objection to this plan, especially from the farmer's standpoint, is the labor involved in covering the pile with soil.

Another method worthy of mention here is that devised by the Maryland Experiment Station and which is described in Farmers' Bulletin No. 1408, page 14. This consists of a wide, shallow concrete tank over which is built a slatted platform. The manure is dumped directly on the platform from the manure carrier and as the maggots develop they drop into the tank below, which is kept partly filled with water and are drowned. This method is completely (*Continued on page* 84)



A soil covered manure heap. The full grown larvae leave the pile and go into pupation in the soil seldom traveling more than ten feet before finding a favorable spot.

* *Farm Sup't St. Elizabeth's Hospital, Dep't of Interior, Washington, D. C.*

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This is the scorpion's method of holding hands with his lady love. During the course of his love dance, he grasps her claws; in this position they see-saw back and forth for several hours.

A pair of scorpions pick up an acquaintance. That's quite an undertaking with a lady scorpion. She usually asks no questions. Just as soon as you come within grabbing distance, she devours you.

The Dance of Death

Love, to Us, is a Romantic, Beautiful Creation, a Prophecy of Joy . . . to Lower Animals, Such as the Scorpion and Spider, It Means an Intricate Dance, and Then Inevitable Death

By Dr. E. Bade

IT is the mating season among the insects. As dusk deepens, the scorpion emerges from his daytime hiding place beneath a rock to hunt, and love.

The love-life of a scorpion is indeed strange. He must approach his prospective mate very carefully. For the scorpion's eyesight is poor and unless he identifies himself (largely through the sense of touch) to the female scorpion, she will instantly devour him. That is why he executes an intricate love dance to attract her attention.

With legs distended, this male spider begins his dance of love.

Slowly, ever slowly, he approaches the desired female with funereal pace, meanwhile waving his jet-black, or black-and-yellow tail high in the air, in all directions. You can see its mobile form extended above his head. With graceful undulating motions he swerves from left to right, till he reaches his mate. They stand head to head, the hairs of their bodies touching—it is through this contact that she identifies him as a male. She lifts her abdomen high; the poison sack it houses touches his. The exchange of poisonous stings injures neither, for they are of the same species.

After a time the male grasps the female by the claws, and walks backward, pulling her along. Soon the order is reversed—she assumes the initiative while he follows. So they see-saw back and forth for hours, till they approach a stone. Never once relinquishing his hold upon her, he digs a large hole beneath it for them to lie in. They both crawl in. . . . Only in rare instances does he emerge; usually the female scorpion devours him, after they have mated. Thus his dance of love becomes a dance of death.

During the course of the dance, he jumps high in the air, to attract the female's attention.

The male spider must dance his dance of love to woo his mate; after they have united, she will kill him.

The same doom awaits those male spiders and crickets who have not met their death through other means, such as the sting of the scorpion. That will not injure a fellow scorpion; it always proves fatal to the creatures upon whom he depends for his daily bill-of-fare. Larger victims are paralyzed, smaller ones, once stung, are torn to bits by his large claws and sharp mouth.

Nature has decreed that the lower order of males most sue for the female's favor, while she calmly watches his performance and then accepts or rejects him. Though it may mean certain death to such insects as the scorpion, spider, or cricket, the male does all he can to attract the female. Nature has painted the pursuer in gaudy hues and given him a distinctive shape to achieve this end. These same distinguishing features also attract his enemies, so that he becomes an easy victim of the hungry prowler. The dark coloring provided the female enables her to escape her hereditary enemies by stooping and remaining motionless. Thus she merges with her background.

Rather an indifferent young woman is the lady animal—the males of all animal groups fight for her possession among themselves, while she stands nonchalantly to one

(*Continued on page 83*)

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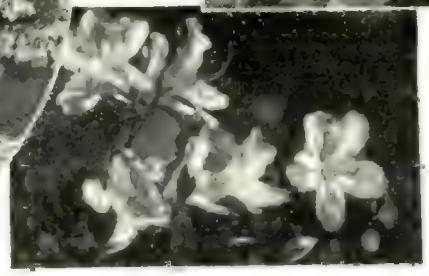
Anemone, popularly known as the wind-flower.

Below—Do you recognize the popular money-worth?

Rhodo-dendron thrives under big trees.

Below — White azalea is often used for window gardens.



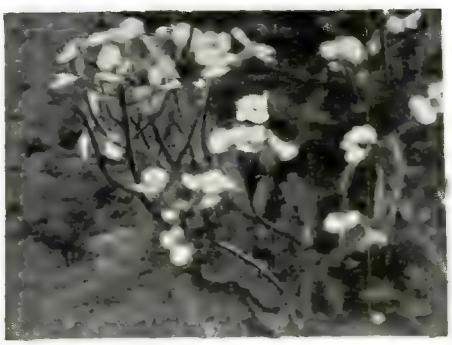
Grow Perfect Flowers in the Shade

Through the Selection of Proper Varieties You Can Raise Flower-Bearing Plants in Even the Heavily Shaded Portions of Your Garden

By B. Francis Edward

THE life and growth of a plant depends primarily upon the available light. Light is essential for the processes of life whereby carbon dioxide and water are changed to organic substances, the final food and structural material of a plant. The plant, therefore, always seeks the light; it turns and follows it as the sun crosses the heavens. Take the light away from the plant and it dies. The formation of organic substances, the assimilation, takes place only when the light is present in a certain minimum proportion. Many plants only do well under the twilight of tall trees or in the shade of a dense forest. Even caves are sought by some plants and the dark clefts in grottoes are not without their plant life. For these types the direct rays of the sun, life giver to many, become death rays. The plants bleach and die for the light that they require is small.

It is true that the number of plants that will thrive with little light is very, very small and the majority of these are without flowers. These facts must be kept in mind when one desires to plant a garden in shady places. The lack of light is a terrible handicap and the selection of plants too small for a choice of gayly colored specimens to be included.



Arabis Alpina, more romantically, alpine youth flower.

Conditions are far different where a partially shaded garden is to be considered. Here many different flowers may be grown successfully. The shade produced by tall trees is of comparatively little importance as compared to the damage that is done by the roots of these trees which follow the surface just below the ground. It is possible to make these places green if the soil is not disturbed. But the gardener says that the soil must be disturbed to permit the free entry of water; if the soil is not disturbed the soil cakes.

Just look at the conditions in the forest. Here the soil is not packed nor baked in spite of all the rain that falls. But the reason for this is the presence of leaf mold, the dead and decaying leaves which litter the ground and prevent the thorough drying out of the soil. This material also tends to check sudden temperature changes so that micro-organisms can work favorably to aerate the soil and bring new food salts to the

(*Continued on page* 68)

White Hellebore flowers early in Spring while snow is still on the ground.

Canadian Azalea serves very well as an ornamental plant.

Mountain laurel, one of the prettiest flowering bushes in the woods.

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SCIENCE AND INVENTION ANNOUNCES

The Winners of the $3,250 Ideal Home Workshop Contest

Robert H. Smith, M. S.

Associate Professor of Machine Construction, Massachusetts Institute of Technology, in charge of the Machine Tool Laboratory. Author of "Principle of Machine Work" and "Advanced Machine Work."

REPORT OF THE JUDGES

As the judges selected to pass on the lists of tools and equipment submitted in the Ideal Home Workshop Equipment Contest, and to make the awards offered by Science and Invention, we are pleased to report the names (arranged alphabetically) of the five winners in each of the three classes:

CLASS A (each to receive $400 worth of tools):

1. **Raymond C. Coll,** 4878 East 93rd Street, Garfield Heights, Cleveland, Ohio.
2. **Thomas Haugen,** Box 402, Lynden, Washington.
3. **William W. Klenke,** 111 Mercer Place, Tuxedo Park, South Orange, N. J
4. **E. Austin Rice,** 2541 East 82nd Street, Chicago, Illinois.
5. **Richard D. Springer,** 500 West Annapolis Street, St. Paul, Minnesota.

CLASS B (each to receive $200 worth of tools):

1. **H. M. Beall,** 170 T Street, N. E., Washington, D. C.
2. **Louis J. Bousquet,** 4318 218th Street, Bayside, New York.
3. **Laurence F. Burns,** 456 Fourth Avenue, New York City.
4. **C. Howard Green,** 2312 B Parker Street, Berkeley, California.
5. **J. R. Meyers,** 9 Washington Avenue, Helmetta, N. J.

CLASS C (each to receive $50 worth of tools):

1. **Robert O. Downs,** 537 Bulen Avenue, Columbus, Ohio.
2. **Sylvester T. Kolassa,** 52 Floss Avenue, Buffalo, New York
3. **George E. Morris,** 663 Locust Street, Fall River, Massachusetts.
4. **Thomas K. Waller,** 2656 Princeton Avenue, Memphis, Tennessee.
5. **A. D. Woods,** Room 624, 45 Broadway, New York City.

This has been an interesting task, though a bit difficult to complete accurately, because so many of the contestants prepared excellent lists of nearly equal merit.

Our decisions have been made on (a) Completeness of Equipment, (b) Quality of Equipment, (c) Nature of Explanatory Material.

Alfred S. Kinsey

Robert H. Smith

Alfred S. Kinsey

Professor of Shop Practice at Stevens Institute of Technology, Castle Point, Hoboken, New Jersey, and Advisory Engineer to Manufacturers in Tool Development.

RAYMOND C. COLL,
First winner in Class A, says:

I HAVE never taken up woodworking as a means of livelihood, but have, nevertheless, been much interested in this work and manage to spend considerable time in the field of mechanics.

Until now I have been seriously handicapped by the lack of good tools, but your equipment award will enable me to spend my evenings to better advantage.

As I have never before been a contestant in a national competition such as the one sponsored by your magazine, you can readily appreciate my surprise upon receiving news of my good fortune.

I am 26 years of age, single, and have lived in Cleveland all my life. I attended West Technical High School here. After leaving school I became employed in the office of a paint and varnish manufacturer. Later I took a position as teller in one of our city's largest banks. I am now employed in the office of the Bourne Fuller Division of the Republic Steel Corporation in Cleveland.

Raymond C. Coll

I appreciate the splendid co-operation received in obtaining the catalogs which were so valuable an aid in selecting the tools.

A résumé of why Mr. Coll selected the tools he did follows:

The tools and equipment I have selected as suitable for equipping an Ideal Home Workshop were chosen after careful consideration of the following points: Quality, Usefulness, Capacity, Price, and Completeness. I believe every man would prefer to build his own workbench and (*Continued on page* 88)

H. M. BEALL,
First winner in Class B, says:

I AM 27 years of age and was born in Washington, D. C. I attended the Grammar School in Alexandria, Virginia, where my family had moved. I later went to St. Johns High School and St. Johns College, both in Washington, D. C. I am a graduate of the latter. I was commissioned First Lieutenant in the Reserve Officers' Training Corps attached to St. Johns College.

Because of my interest in drafting, I took a special course in mechanical drawing in the Columbia School of Drafting. At present I am a locomotive fireman for the Washington Terminal Company. Am married and have two daughters and one son.

Most of my spare time is spent in studying. My particular interest is mechanics. My hobby is model making. Now I am constructing a locomotive model.

Here is a résumé of why Mr. Beal selected the tools he did for the $200.00 Division:

H. M. Beall

The first of the power-driven tools is very compact in construction, measuring 20 × 24 inches, and weighing only 75 pounds, easily installed and can be moved from place to place and can be plugged into any light socket. It has a sanding belt and table, circular saw and table, adjustable, with rip and mitre gauges, saw guard, emery wheel and guard and drill chuck. It is driven by ¼ horsepower motor. This woodworker is so constructed that a lathe, hand saw or any other machine (*Continued on page* 93)

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Man—A Tool-Using Animal

So You Would Agree, If You Were to Read the Many Thousands of Entries in Our $3,250.00 Ideal Home Workshop Contest . . . Here We Present Impressions Together With Valuable Suggestions for the Care of Your Tools

By Alfred S. Kinsey

Professor of Shop Practice, Stevens Institute of Technology, Member American Society Mechanical Engineers

CARLYLE'S description of this creature is unique: "Man is a tool-using animal. Weak in himself and of small stature, he stands on a basis, at most for the fattest-soled, of some half-square foot, insecurely enough; has to straddle out his legs, lest the very wind supplant him. Feeblest of bipeds! Three quintals are a crushing load for him; the steer of the meadow tosses him aloft, like a waste rag. Nevertheless he can use tools, can devise tools; with these the granite mountain melts into light dust before him; seas are his smooth highway, winds and fire his unwearying steeds. Nowhere do you find him without tools; without tools he is nothing, with tools he is all."

If that were true in Carlyle's time, over a hundred years ago, what might be expected of a man who has a shop equipped with modern tools and in whose veins flows the blood of this iron age?

What a transformation has been going on in the design of even the most common of hand tools! It takes fifteen different precise machine operations to produce the right kind of auger bit. The forming, heat treatment and balancing of a hammer, the development of a wood plane, the versatility of a combination tool, the accuracy within four decimals of some other tools all bear plain evidences of man's determination to have the most efficient tools.

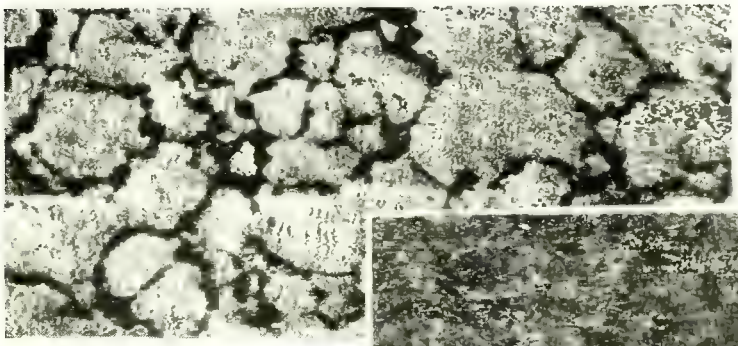
The SCIENCE AND INVENTION Home Workshop Tool Equipment Contest has been a revelation in this regard. More than 5,000 men have shown unusual interest in hand tools. Fifteen of these contestants won prizes valued at $3,250.00 for the completeness of their lists; many came close to winning; others should be commended for the fine work they did. But some did not do so well—they thought only of tools for the working of wood and left out the tools for metal; there was not a single wrench in some lists, and hence no way to replace a leaky faucet washer; roof leaks would continue because a soldering copper had been omitted; some even forgot that tools will get dull, for no grinding wheel or oil stone was provided; there was no hammer in some lists; a Stillson wrench unmentioned in others; some included several items of *materials*, which are not *tools;* not quite enough of the contestants made a complete, workable outfit. And in addition some of the stories of why the tools were selected might have been much better.

With this steel gauge, you can accurately measure the angle for grinding tools correctly.

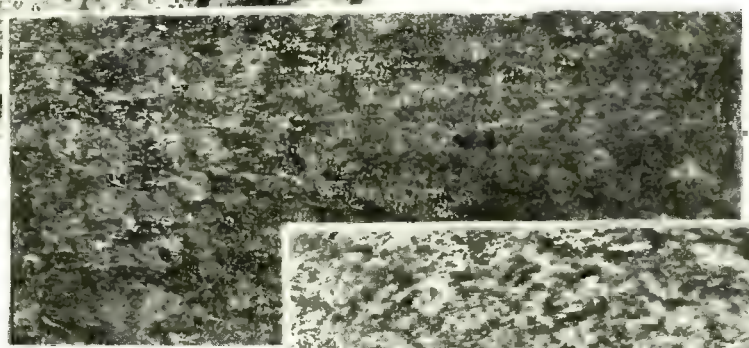
Such a collection of ideas made the work a bit tedious for the judges, but none the less interesting and of good educational value. The enthusiasm of the winners of the prizes may easily be imagined when they receive their prize set of tools.

It would be natural to wonder how those tools will look a year later, for usually the way a workman keeps his tools indicates the kind of work he is likely to produce. The care of tools does not end with keeping them free of rust and split handles. Many mechanics do not know the fundamental principles governing the perfect action of the modern steel tool.

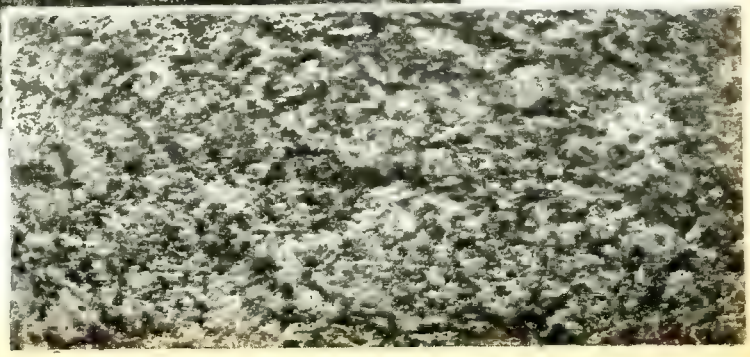
For example, too often a new wood chisel is ruined at its first grinding, done on a *dry* wheel. The durability of its cutting edge depends chiefly on the temper of the steel. To heat the tool means to reduce the temper and soften the edge. Most workmen think the temper is safe so long as the surface is not heated to a blue. But that is not so, for the temperature corresponding to that color is about 550 degrees Fahrenheit, while the temperature at which the hardening carbon forming the temper of the steel (*Continued on page 87*)



Photomicrograph of tool steel in the annealed (unhardened) condition. The gray area is pure iron, the black is carbon. Both must be combined at a high temperature to make strong tools.



The same tool steel after the tempering process, which produces the best tough-hard condition for edge tools. Moderate heat would further separate the carbon and iron, reestablishing the original condition.



The same tool steel, after complete hardening of iron and carbon through heating and quenching. Too brittle for edge tools, it must be tempered

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Poisoning Trees to Make Indestructible Piles

By George A. Pettitt

A NOVEL method of preserving wood from the destructive action of marine borers such as the Teredo, the Bankia, and Limnoria, and from such land parasites and pests as fungi, bacteria and the cellulose-eating termites (erroneously called 'white ants'), has been patented by the University of California and two members of its staff, Dean Charles B. Lipman and Aaron Gordon, research assistant.

In place of seeking to coat or soak piles, telephone poles and building timbers with some preparation after they are cut and ready to use, the new protective substance is injected into living trees while they are standing in the forest. The method might be compared to the old process of embalming which the Egyptians developed to such a high degree in preserving their relatives, crocodiles and cats.

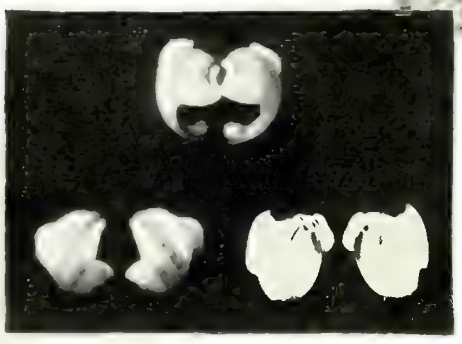
The destructive attacks of such borers, parasites and insects as those mentioned above, have led to the loss of billions of dollars in ships, wharves, and dry land structures in most parts of the world. In addition to the direct loss, many millions of dollars have been spent in experiments to protect wood against their depredations. In the case of marine piling, dozens of methods of protection have been tried with partial success. On the Pacific Coast, exasperated engineers have even tried to kill the boring organisms by chlorine liberated in the water around the pile through electrolysis and by detonating dynamite under water.

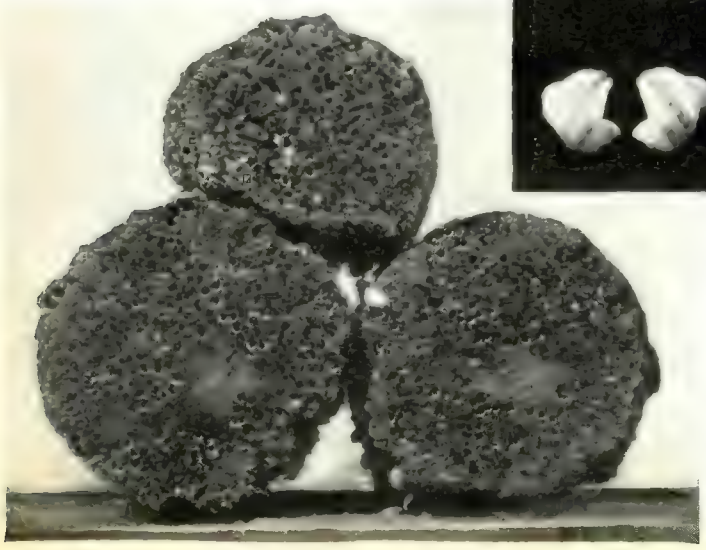
The above provides a graphic illustration of the damage done to wooden piles by the combined attack of various marine borers.

The application of creosote by a vacuum pressure method, however, has apparently proved to be most successful. This method, when adequately applied, costs approximately $95.00 for an average large pile, though a few run less and some as high as $150.00. The new Lipman-Gordon method of "embalming" is estimated to cost $5.00 or less a tree. The creosote method, furthermore, does not always insure an even impregnation and at best soaks into the pile for less than an inch or inch and one-half. The Lipman-Gordon method is designed to impregnate the wood with a deadly poison (a copper-arsenic compound), from the surface to the heartwood, and occasionally into the heartwood. Creosoted piles sometimes fail because of checking, chipping or abrasions which destroy the thin protective layer of wood and allow the borers to gain access to the untreated centre of the timber. The new method of embalming the entire trunk reduces the chances of this occurring.

The Lipman-Gordon method of tree-embalming is more economical than processes applied after cutting because the tree does most of the work. By taking advantage of the movement of sap in the tree's circulatory system, the inventors are able to send poison to every cell in the tree's tissue with a minimum of labor. Science has not yet found a completely adequate explanation of the movement of sap in trees, though it is known that sap moves not only during the spring, but also, more slowly, throughout the entire year.

Two small telephone poles as they appeared after four years exposure to fungus attack in swampy land. The test pole, at right, is entirely free from attack and absolutely clean, because it received a poisonous injection before being cut. The check pole, received no treatment and, as can be seen, is rotted almost in half.





Above—The cutters of shell from the heads of the Bankia Setacea. By opening and closing these cutters, the pests can bore through solid timber in a few weeks. Left—Cross-sections of piles attacked by borers. Externally they still look solid.

In detail, the new process is as follows. From one to three days before a tree is to be cut, depending on the season, the bark is ringed about three feet from the ground. Around this ring, at inter- (*Continued on page 79*)

Photos courtesy Prof. Chas. Atwood Kofoid, former chairman, San Francisco Bay Marine Piling Committee

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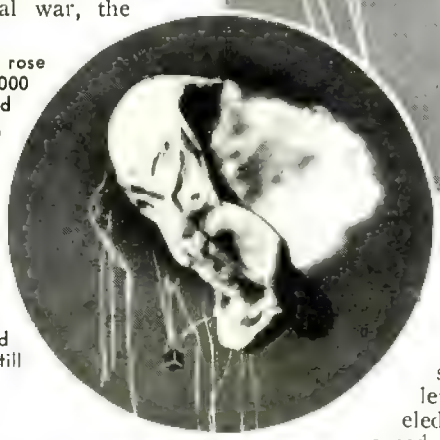
United States Army Plane Bombs Sausage Balloon

AT the recent balloon bursting contest held at Langley Field, Virginia, the sausage balloon pictured below didn't stand a chance.

It had been specially made, was flown to an altitude of 2,000 feet, and anchored there for the express purpose of giving pilots of the United States pursuit planes a chance to test their ability to hit such a target with bombs. As can be seen from the lower illustration, they were eminently successful. One of the bombs released by First Lieutenant Guy V. McHenry caused it to burst into flames. It drifted to the ground, still blazing.

Balloon bursting contests, catapulting planes into the air with compressed air guns, staged battles for conquering a city, are maneuvers that will stand our aviation fleet in good stead, in the event of another war. For it will be a war fought largely in the air, or a combination of air-and-land or air-and-set tactics.

At the mimic four-day conflict, the Navy's annual war, the Panama Canal territory was protected from an enemy attack. And it was the flying fleet, not the navy, that decided the outcome!



The sausage balloon rose to an altitude of 2,000 feet and was anchored by means of ropes, fastened to the ground. Then U.S. Army planes attempted to destroy it. A bomb directed by Lieutenant Guy V. McHenry did the trick. The balloon burst into flames and drifted to the ground, still burning.

Lincoln's Interest in Aviation

"WILL Lieut. Gen. Scott please see Professor Lowe once more about his balloon. A. Lincoln. July 25th, 1861." This note, penned by Abraham Lincoln, was responsible for the first use of balloons in warfare in the United States.

Lincoln's interest in lighter-than-air craft resulted through a successful balloon flight which Professor Lowe made from Washington to the South Carolina coast just seventy years ago. The flight required nine hours and fifteen minutes. Now it takes but one-fourth of the time.

This information was recently extracted from historical documents obscurely filed away in the collection of Henry Woodhouse, president of the Aerial League of America. A true copy of the first telegraphic message ever sent from an aircraft was also found, addressed to President Lincoln. It reads in part:

"Dear Sir: From this point of observation we command an extent of country nearly fifty miles in diameter. . . . I acknowledge indebtedness to your encouragement for the opportunity of demonstrating the availability of the science of aeronautics in the service of the country. I am Your Excellency's obedient servant,

T. S. C. Lowe."

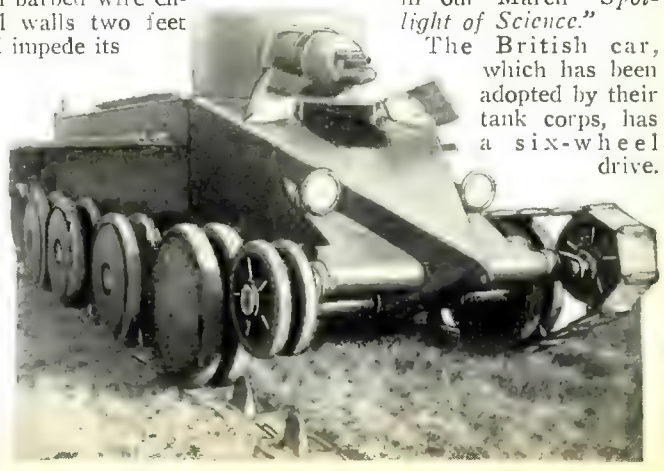
An Innovation in War Tanks

BUMPING over logs two feet thick, sloshing through ponds, spinning about in its own length, this war tank traveled over rough ground at a speed of forty-five miles per hour. It smashed barbed wire entanglements, crumbled walls two feet thick . . . nothing could impede its march.

The caterpillar tracks it used for traveling over rough fields were quickly removed, as the photo shows. When this was done the tank roared over a paved highway on solid rubber wheels at seventy miles per hour.

This war tank, which is equipped with double wheels and carries its own caterpillar treads, is the first of its kind tested. It weighs nearly ten tons and is powered with a 338-horsepower Liberty airplane motor.

Our English cousins are also interested in developing a fast war tank. Their latest development was described in our March *"Spotlight of Science."* The British car, which has been adopted by their tank corps, has a six-wheel drive.



It Is Perfectly All Right to Be Left-Handed

MARY and John are not abnormal if they are born left-handed, nor have you any cause to feel ashamed of them on this account, says Dr. Ira S. Wile, of the American Orthopsychiatric Association. Enforced right-handedness, on the other hand, is all wrong, he claims. The number of reputable psychologists who agree with him is legion.

If a child is left-handed, leave him alone. Trying to make him write, as a right-handed person would, is wasted effort. Besides, it may slow up his mental processes, make him nervous, and "provoke tantrums, pugnacity and secludedness." His speech may even be affected—he may stammer or stutter.

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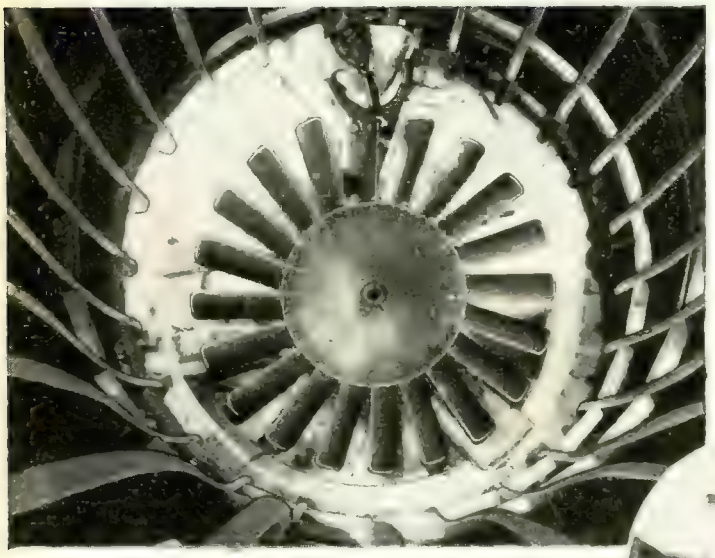
Vertical Wind Tunnel Tests Plane Spins



The Sikorsky vertical wind tunnel for testing spins. The building is 24 feet in diameter, and 32 feet high. The wind tunnel has a five foot diameter, five foot length, free stream experimental section.

Inside the tunnel, looking up. The foundation consists of an inner concrete block supporting the motor and fan, and an outer block supporting the walls and inner structure. Both are separated by a shock-absorbing layer for preventing vibration.

A VERTICAL wind tunnel, the first of its kind in the world, designed by Professor D. E. Olshevsky of Yale University, was recently built for the Sikorsky Aviation Corporation at Bridgeport, Conn. It was primarily constructed to aid in the experimental investigation of spins. Its sponsors felt that a free or properly suspended model plane in a vertical airstream represents a closer approximation of actual conditions as they occur in a spin than are generally obtainable. The tunnel has been found to aid in aerodynamical research generally.

The vertical arrangement of the tunnel through which the air current passes results in an experimental section easily accessible and observable from all sides or through 360°. Since direction of wind velocity and force of gravity coincide, any position around the air-stream is perfectly identical from the standpoint of measuring balances. An observer can go around the air-stream, remaining on the same floor level, and be in the same position with regard to observation. In addition a saving in space and building costs results.

The tunnel consists of an inner body of rotation housed within a coaxial vertical cylindrical shell. The inner body of rotation has an air passage passing through the experimental chamber. The air flow produced approximates that of a vortex ring.

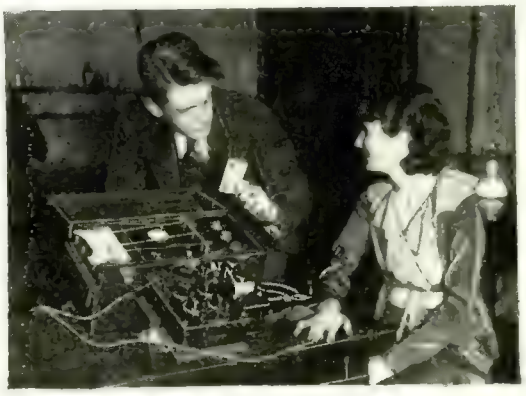
Lead Poisoning from Toys and Cribs

THE United States Public Health Service reports that, in spite of the precautions taken by parents, several cases of lead poisoning of children and infants have been reported. It is pointed out that while lead has wide fields of usefulness, the painting of babies' toys and cribs is not one of them. Manufacturers have been warned against using lead paint for dolls, wagons, trains, and other toys.

Parents themselves are often at fault. Though they realize that baby will put into his mouth almost everything he lays his hands on, particularly at the teething stage, they coat cribs and cradles with lead paints, instead of employing the quick-drying lacquers and enamels sold for interior use.

A 200-Pound Force Can't Separate Them

THESE two Johannson precision gage blocks are placed together by a slight sliding motion. Because of the nearly perfect parallel surfaces, they act as if magnetized and cannot be pulled apart by force of 200 pounds exerted in a straight pull. Johannson gage blocks and other precision instruments were first introduced in the United States in 1907, at which time they were regarded by manufacturers more as a novelty than as useful instruments. Today they serve as the standard of comparison—the master inch—in Washington, Paris, London, Ottawa, Berlin, Berne and Leningrad. An article descriptive of them appears in our July, 1930, issue.



German Seaplane to Accommodate 180 Passengers

THE Dornier DO-X, the largest flying seaplane in the world, which has a capacity of 150 passengers, will soon have to relinquish its place at the top of the list if the plans of Dr. Rumpler, noted German aircraft designer, materialize. He is in Berlin, arranging for the construction of a new plane. It will accommodate 180 passengers, carry several tons of mail and sufficient fuel for a 4,000 mile non-stop flight, when fully loaded. Passenger accommodations are in the wings. Dr. Rumpler is displaying the model.

Above — Two Johannson gage blocks, accurate to four-millionths of an inch. Left—Model of Dr. Rumpler's proposed 180-passenger seaplane.

Be Careful, Now—Don't Lie

"WHERE were you?"—tell the truth, because if you don't, the lie detector developed by Leonarde Keeler will find you out.

Mr. Keeler, who demonstrated his apparatus before the Chicago Medical Society, did not intend it to be used only as a truth indicator. He expects it to be of value to scientists who are studying the causes of certain nervous diseases.

Mr. Keeler believes in addition, that by using it doctors will be able to fully acquaint themselves with the influence of the ductless glands on human conduct. The contrivance is minutely adjusted to record slight emotional changes of the person being examined; if he deviates from his accustomed mode of speech to a marked degree, he is lying (or at least he should be). No lie detector yet devised has ever proved to be 100 per cent accurate.

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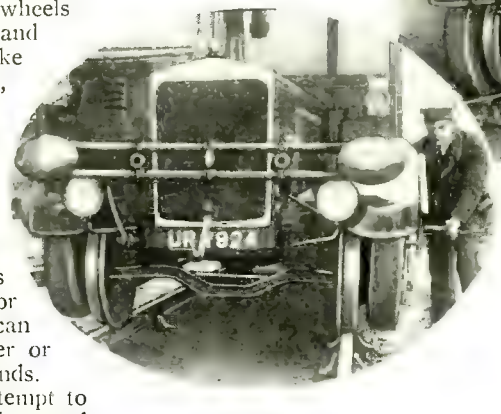
Ro-Railer Rides Rail and Road

BY the simple movement of a lever on this novel railway coach of the London, Midland, & Scottish Railway, it is possible for one man to convert it into a motor vehicle in less than five minutes. It has two sets of wheels. One consists of the regulation flanged wheels common to all railroad cars, and the other includes four pneumatic tired disc wheels such as grace almost every omnibus. When the coach operates over rails the rubber tired wheels are raised from the ground and locked in position. To make the Ro-Railer leave the rails, the automobile type wheels are lowered, the rail-wheels raised, and the vehicle is ready to speed over the highways. This can be seen clearly from the illustrations.

The combination car has been designed principally for use on surburban lines, and can be attached to regular passenger or freight trains, if occasion demands.

This Ro-Railer is the first attempt to combine in one vehicle the safety and comparatively low operating costs of a railroad train, with the convenient door-to-door transportation of the automobile or truck. It was recently tried out at Redbourn, Herts, with great success.



The Ro-Railer on railroad tracks with the automobile wheels in position, ready to take the auto off the rails. Below—A turn of the crank and the auto wheels are lifted so that the weight of the coach rests safely on the railroad wheels.

The Latest in Divining Rods

THE "Hotchkiss superdip" is the name of the latest divining rod, with which it is claimed several thousands of diamonds, including one weighing 20¼ carats, have been located in Pike County, Arkansas. According to Noel H. Stearn, consulting geologist of St. Louis, the mechanism will function equally well for ferreting out oils, silver, gold, lead and other mineral deposits.

Essentially the rod is operated by balancing the force of gravity against magnetic force. Each mineral has its own characteristic magnetic reaction, which affects the strength of the normal magnetic lines of force for that locality. The "superdip" registers the amount of variance from the normal at a certain point, from which information the prospector is supposed to judge the particular mineral deposit present beneath the earth's surface.

Artificial Leaves from Fireproof Celluloid

HERETOFORE artificial leaves were molded of wax. In temperate weather, they kept their shape beautifully. But on hot summer days, the leaves softened. A new press has been perfected which makes such artificial leaves from fireproof celluloid.

The process of manufacture is rather interesting. A two-piece plaster cast is made of a real leaf, one piece for the upper and one for the lower surface. A duplicated metal mold is made from the plaster cast. The mold contains an electric heating unit. The sheet of celluloid is softened by the heat as it lies between upper and lower dies and is pressed into the desired leaf shape. The green, or yellow, russet or whatever tone or combination of hues desired, is sprayed on with an air brush. Mr. E. G. Wright, of the Chicago Academy of Science, is removing one of the celluloid leaves from the mold.

Creating a Human Voice!

"ALL-of-a-tremble." With a pronounced English accent these words were uttered by a mechanical robot. The syllables were not reproductions of a previously uttered human voice. For E. A. Humphries, the English sound-film engineer, had created a synthetic voice from nowhere, and reproduced it on a celluloid film, as he would a talkie. It had taken him 100 hours to achieve this result. "In order to create a synthetic voice," Mr. Humphries explained, "I had to analyze the sounds I was required to reproduce one by one from the sound tracks of real voices. . . . One by one I drew them through a magnifying glass on my cardboard strip. Then I joined the strip together with the sounds in their proper sequence, photographed it on standard celluloid film—now we can go and run it through a standard talkies projector."

Pioneering in a Rubber Glider

WE have had gliders of wood and gliders of metal—the latest development in glider construction is the rubber glider pictured below. It is built principally of rubber tubing, and is inflated with air like an automobile tire. The craft was given a test flight for the first time recently, which ended in a near-tragedy. The glider took off beautifully, rose to an altitude of 100 feet, and then crashed to the ground.

Its pilot, Joseph Bergling, of the D. C. Air Legion, was pronounced uninjured at the hospital; the plane was intact, except for damaged wire supports. Bergling, W. T. Grady, and C. E. Phillips, all residents of Washington, D. C., designed and built the craft.

The initial flight of the first rubber, air-inflated glider. Right—Bergling seated in the craft, ready for the take-off.

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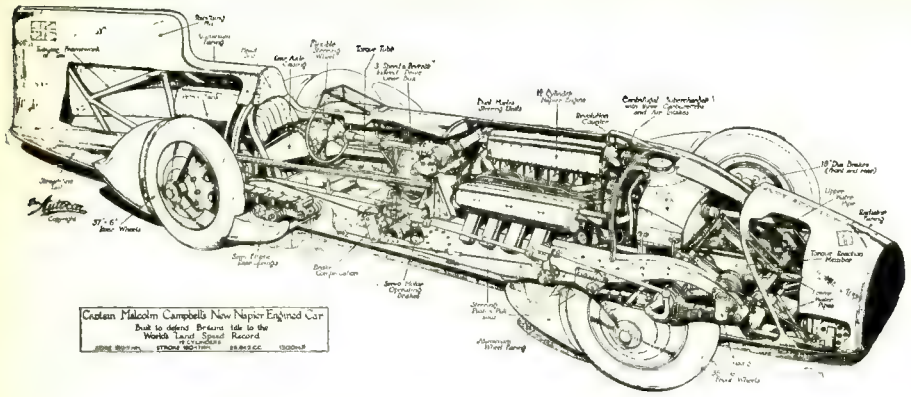


Four Miles a Minute in an Auto

ON February 5, 1931, Captain Malcolm Campbell set a new world's record for automobile racing at Daytona Beach, Florida. He attained a speed of 245.733 miles per hour, as against his predecessor's, the late Sir Henry Segrave's record of 231.363 miles per hour.

For the test, in which he went four miles a minute, Captain Campbell used his Napier-Campbell car, a diagram of which is shown above. The car is powered with a Napier-Lion twelve-cylindered "broad arrow" aviation engine, similar to the one used by A. H. Orlebar in his seaplane, when he won the Schneider Trophy in 1929. It is provided with a supercharger and capable of developing 1,450 horsepower.

The passing of the drive through the gear box permits the propeller shaft to be placed at the side of the chassis, instead of in the center. In this way the driver's seat is set low in the chassis, lowering the center of gravity of both car and driver. The high fin at the rear is intended to hold the car in a straight line, after it has been headed in the right direction and has attained high speed.

Asked how he felt during the ride, Captain Campbell answered, "I guess the biggest thrill I got was when I took a bad swing just before I entered the mile on my south run." Because of a heavy mist he almost missed the fairway.

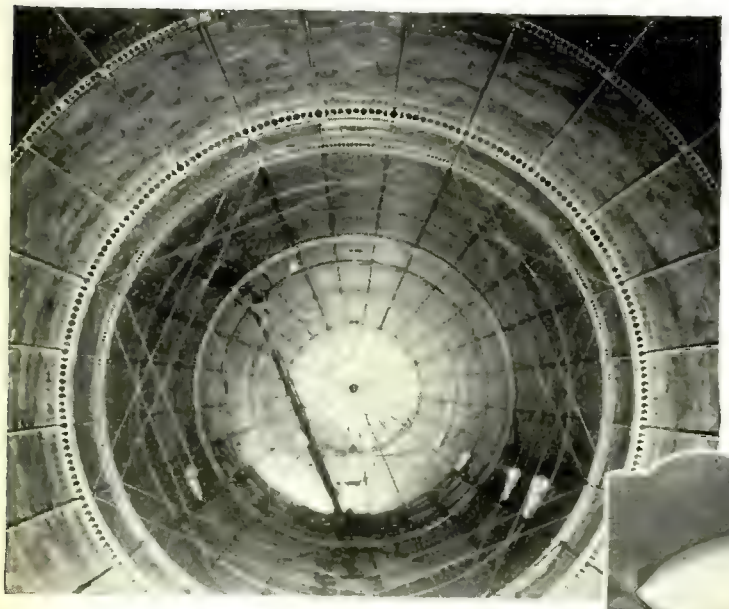
Metal-Clad Dirigible Model of Mammoth Army Craft

A BILL is now before Congress requesting the appropriation of $200,000 to carry on experimental work for the proposed $4,500.000 all-metal-clad dirigible to be built for the Army. The proposed lighter-than-air ship will be 19 times the size of the all-metal dirigible built by the Detroit Aircraft Corporation for the Navy in 1929, an interior view of which is presented below. Perhaps it is a miniature model of what the inside of the mammoth craft will be like.

Instead of the usual highly inflammable fabric covering, a new metal, Alclad, one of the lightest and strongest, will be used for the ship. Sturdy metal circular rings and longitudinal members will reinforce the shell of the ship, which will carry a large part of the stress. The shell will also act as the gas container (helium gas will be used to eliminate the possibility of explosion or fire) and thus make the ship safe.

Should money be available for immediate use, the ship could be ready for service in 1935.

Carrying a crew of 40, the boat will have sufficient fuel and supplies to maintain independent flight for 22 days. Provision will be made for carrying a load of 40,000 pounds, exclusive of fuel and supplies.



An interior view of the all-metal clad dirigible built for the Navy in 1929, upon which the Army's huge ship will be patterned. Right—Exterior view of the proposed mammoth craft.

Kites Carry Broadcasting Stations

KITES carrying wireless transmitters are now being used at the Radio Research Bureau at Slough, England, in making direction-finding tests. Each kite carries about 100 feet of aerial and the transmitters, which are single tube sets, powered by eight dry cells, weigh a little more than one pound.

Engineers are attempting to determine with these outfits the cause of the erratic conditions of reception commonly encountered at night. The transmission range is about one half a mile and the kites ascend as high as 500 feet. Here we see one being launched.

Doubling Ticker Tape Speed

THE "broad tape" of the broker's office will be broader, and twice as fast, after April 13th. On that date the Bell Laboratories are installing for the New York News Bureau, which transmits news of financial developments, a new ticker machine to reel off stock and bond quotations. Words will be rapped out at 60 words a minute, instead of the 30 produced at present. The new transmitting machines operate on the principle of a typewriter. Messages will be typed in the news service office on a machine resembling a typewriter and will appear almost simultaneously on the receiving instruments.

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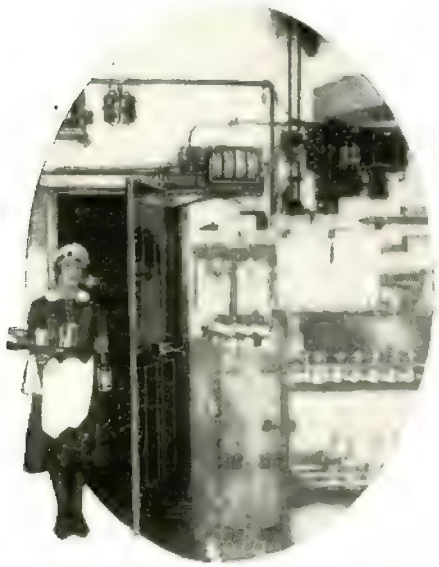
Kay Don Breaks World's Outboard Record

IN the teeth of a booming gale on Lough Neogh, Ireland, *Miss England II*, with Kay Don at the helm, attained a speed of 110 miles per hour, shattering the last world record of 98.76 miles per hour made by his fellow-countryman, the late Sir Henry Segrave. In the photograph we see Kay Don accomplishing the feat.

As a matter of fact, it was while piloting *Miss England II*, that the former record holder was killed.

"Open Sesame" Functions at London Restaurant

WAITRESSES at the Messrs. Kyons', the well-known London caterers, are quite proud to be employed there. To make it easier for them to get into the kitchen, the management has installed a door which opens of its own accord.



The door operates on practically the same principle as the device which protects treasures at the Royal Academy in London. An invisible light ray is again utilized. About ten feet away from one of the service doors a light has been adjusted to shine on a photo-electric cell suspended opposite. When a waitress approaches the door, her body intercepts the line of light. The photo-electric cell builds up a high resistance, a relay operated circuit is closed, and the door swings open.

Studying High Speed Machines in Motion

A NEW type of stroboscope, designed to study motion so that the action of machines operating at high speeds can be watched, has been developed at the Massachusetts Institute of Technology by Harold E. Edgerton. Photographic exposures with the new equipment are made at ten one-millionths of a second.

The unique feature of this stroboscope is the electrical circuit, which causes a condenser to discharge periodically through a thryaton mercury arc tube. An intense blue actinic light of extremely short duration, timed to correspond with the speed of the machine under observation, is produced by a heavy current through the tube. This makes it possible to adapt this stroboscope for photographic as well as visual observation. Heretofore its use has been restricted to the latter.

Still and motion pictures of a 160-horsepower motor have been taken while the machine was running at full speed. In the photograph, we see Mr. Edgerton watching the thryaton mercury arc tube, while it illuminates the revolving rotor of a 160-horsepower motor. Though the rotor was revolving before the camera lens at a rate of 95 miles per hour ground speed, every detail of the moving parts stood out clearly. Thus it was possible to study the characteristics of the machine, from the instant power was applied until it reached full speed.

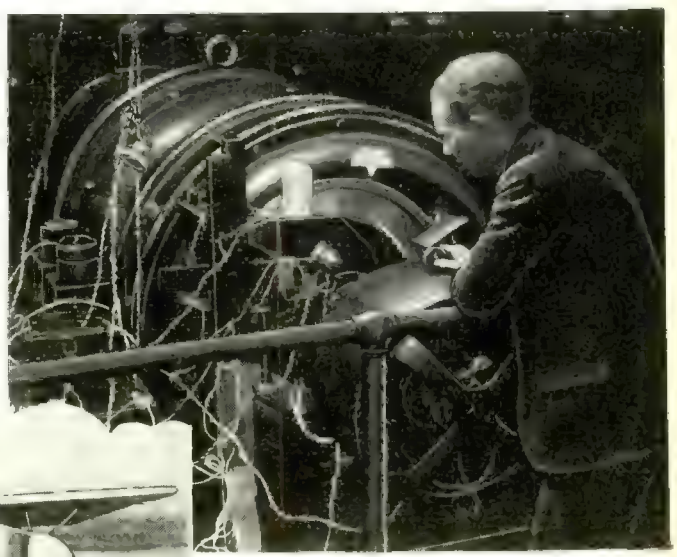
The instrument will prove particularly valuable for studying electrical machinery. Highly accurate studies of the angular displacement of motors, generators, condensers, and lines during switching or short circuit disturbances will be possible. The behavior of cams, springs, valves and other moving parts will also be watched.

In the steel industry and many unrelated manufacturing processes, motors are often subjected to violent load changes. The Edgerton machine will make it possible to both see and record what happens to motors under these conditions of unusual stress.

A Sport Plane for $1490

IT seems the age of flivver planes has come. Instead of saving money for a new roadster, the up-to-date young man or woman will go out and purchase a low-priced airplane, sport model. There will be quite a selection, too.

The latest model offered to the public is the "Junior." The Curtiss-Wright Airplane Company of St. Louis has announced production of this tandem-type sport plane, pictured below, to be retailed for $1,490. The craft is powered with a 40-horsepower, air-cooled engine, mounted on the trailing edge of the wing.



This snap shot of a 160-horsepower motor, running at full speed, was made with the new Edgerton stroboscope, which permits both observation and photographing of machinery running at high speeds. Note the clearness of the details.

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Why Go to Mountains for Trout Fishing? Use a Miniature Golf Course

IF the people of the city of Los Angeles will not come to the mountains for trout fishing, the trout will come to the heart of the city. So reasons the owner of a miniature golf course. And his reasoning appears to have met with the unanimous approval of the people.

Trout is brought in from the mountains by huge motor-trucks, and dumped into this artificial trout-stocked lake as quickly as the fishers catch them.

Approximately 10,000 mountain trout are stocked in this pool, built on a pee-wee golf course. Living trout are brought into Los Angeles by tank motors from the mountain lakes. They are dumped in as fast as the eager public catches some of the older occupants of the pool.

The new winter sport, conducted without benefit of rivers or mountains, may be a source of contempt and scorn to the dyed-in-the-wool followers of Isaac Walton . . . but to the majority of people, who may never have hooked a fish, it will be more than welcome. Poles and bait are rented.

Here's one feature of the artificial lake that may coax even the experienced fisherman to go trout baiting: payment is made according to the number of fish landed.

No longer need you sit for hours at a stretch, with the sun pouring down on your head and back, feeding your line fresh bait and waiting patiently for some guileless trout to come up and nibble. Here it is only a minute or so before you get a bite.

Phonograph Records From Slot Machines

UPON leaving a London Theatre this young lady inserted a coin in a slot machine, and, presto, out came a victrola record of the hit of the show, for her to take home and play. The record, made by the Filmaphone factory of London is of a new non-inflammable material, seven times lighter, and only ⅛ as thick as the ordinary record. Slot machines, installed in moving picture houses, theatres, and outside of shops, will render purchasing these records very convenient.

Forming World's Largest Man-Made Lake

THE gates of the Bagnall Dam, at Damsite, Mo., have been closed. Back of their mighty bulwarks, mortised into the bedrock of the Osage River channel and the cliffs to the other side, is being created the largest artificial lake in the world. As the waters deepen, they will cover a valley for 125 miles, flooding more than 60,000 acres. Thirteen hundred miles of shore road will be ready for tourists along the lake. Above the dam a State highway will run for half a mile.

The carrying-out of the project will cost about $30,000,000. The electric plant it operates will have a capacity of 268,000 horsepower. Current will flow over high tension lines to St. Louis and to lead mines in Missouri. The plant will be completed by next summer, at which time the lake will also have reached its predetermined limit.

Shopping Made Easy in the "Delamat"

IF "Delamats" gain popular favor, shopping for the average housewife will be very easy, indeed. A trip to one will enable her to obtain, very quickly, everything she needs for preparing the day's meals. After more than three years of experimentation, N. Robert Harvey has developed a system which, it appears, may revolutionize the methods of retail merchandising, resulting in a saving of time, effort and money to the public.

It is a series of machines (similar in appearance to the compartments of our Automat restaurants) which deliver any article now purchasable in retail food shops, automatically. The machine is not limited to any one type of food; it handles glass packed articles as well as canned goods.

Each section compartment is labeled as to details of the article and price; one selects what he wants, drops in a coin, turns the handle, and the food appears. The picture shows Miss Clara Waring, of New York City, purchasing a refrigerated steak. All equipment in the shop is electrically powered.

Six Machine Guns Shoot Simultaneously from Plane

THE "Interceptor" model single-seat plane of the British Air Ministry is the deadliest and fastest-climbing military craft produced to date. Six machine guns can be fired simultaneously by the pilot's pressure of a single trigger. Four guns are fixed to the front of the wings and one gun is placed on each side of the engine.

Just walk along the length of the store, read the labels above each compartment. When you decide what you want, drop in the coin specified, and the item will appear, wrapped and ready to be carried home.

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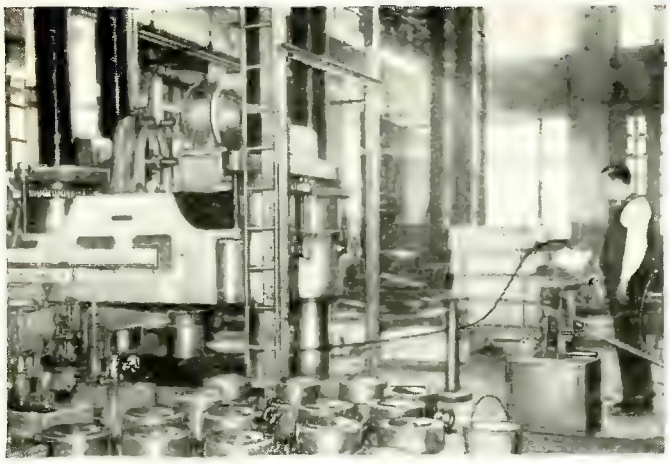

Smaller jacks, such as those used for automobile lifting, are portable. But how would you like to use one of these hydraulic jacks, with its lifting capacity of half a million pounds? Dr. Strang of the Bureau of Standards, Washington, D.C., observing one being tested in the testing machine, which can produce a 10,000,000 pound strain.

Hydraulic Jacks Lift Over Half Million Pounds

ENGINEERS of the Bureau of Standards have undertaken the task of testing several powerful hydraulic jacks. They will be used by the Bureau of Public Roads for erecting a bridge in Oregon. Each jack has a lifting capacity of more than a half million pounds. In the photograph we see Dr. Al. H. Strang of the Bureau, observing one of the tests through which the jacks are put. They are being calibrated in the giant machine which can exert a testing strain of 10,000,000 pounds.

Electric Ear Detects Engine Knocks

RADIO science has entered a new field—that of measuring anti-knock qualities in gasoline. Microphone and vacuum tubes, magnifying sounds a hundred fold, have been combined with other delicate instruments to form an electrical ear to detect the faintest whisper of a knock, and yet remain deaf to other engine noises.

In operation, a microphone is suspended from coiled springs near the engine. Sounds that cannot be heard by the human ear are picked up by the microphone, and the rest of the apparatus then selects and magnifies the knock and registers the sound intensity on the dial of a sensitive meter. Normal engine noises are screened out.

Doubling the Microscope's Range

WE shall be able to achieve crisp, brilliant images at twice present limits . . . and we shall have better optical and mechanical means at our disposal," says F. F. Lucas, metallurgist and microscopist of the Bell Telephone Laboratories, in commenting on a new microscope, recently developed at the famous works in Jena, Germany.

This new machine will be particularly helpful to metallurgists, for it can penetrate metals. Mr. Lucas has a series of photographs of steel, taken with an ultra-violet microscope he invented six years ago. Steel was magnified 3,500 times. The photographs showed the numerous faults that developed in the metal during the tempering process.

Milady May Have New Mirrors

THE old superstition of seven years hard luck because of your breaking a mirror may become obsolete, very fortunately. C. Hawley Cartwright, pictured above, a physicist at the California Institute of Technology, is developing more durable mirrors.

In a high vacuum nineteen different metals, some alloys and a number of non-metals have been deposited not only on glass, but on metal, paper, cloth, rubber and nitrocellulose membranes, making mirrors claimed to be far more durable than any made heretofore.

The advent of this system may aid in the construction of curved mirrors, costumes, and advertising displays.

Huge Rock Slide Changes Niagara's Shape

THE life of Niagara Falls, that Mecca of American and Canadian tourists, is slowly approaching its end. The cataclysm of January 17, which changed the contour of the crest of the American Falls, brought this fact sharply to mind. The downpour of 500,000 tons of water a minute gradually wears away the rocks over which the water dashes. Unless, of course, man creates a synthetic falls, by building weirs and canals to manipulate the flow of water and distribute it evenly, or reinforces the falls with steel and concrete, this spot of beauty will perish.

According to geologist's calculations, the falls will be completely eroded by 20,190 A.D. Of course, a considerable change has taken place since they came into being at a date not yet determined, but predicted as about 50,000 years ago. Once a trim half circle, the Canadian side of the cataract, which carries 94 per cent of the downpour, has gradually assumed the shape of a horseshoe. Now the American side is becoming a miniature replica of it.

The dotted line of the sketch indicates the edge of the rock before the slide; the photo is a reproduction of the American side as it appears today. According to witnesses, there were two distinct rock slides, each hurling thousands of tons of rock into the gorge.

The Niagara State Reservation Commission ordered an aerial survey to determine the exact extent of the slide. It was its plan to shunt enough water from the Canadian side to fill up the gaps in the American side.

The Niagara Falls from the American side, after the rock slide of January 17th. Dotted line shows edge of rock before slide. Below — A stirring view of the mighty falls after the crash. In the foreground are the great masses of rocks and ice which fell from the crest.

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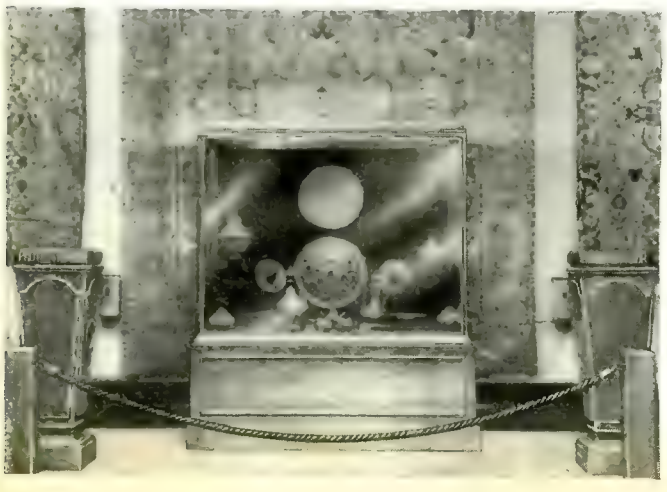
Saving Both Patients and Doctors

THE most modern Roentgen Institute in the world, containing the latest improvements in X-ray machinery and practicing the most advanced technique in treating patients, has been completed at Frankfort, Germany. It was built in accordance with the plans of the famous roentgenologist, Professor Holfelder. In order to safeguard operating physicians the machines are specially equipped with safety devices which prevent radiations from reaching the body of the technician. In the photograph we see a patient being examined . . . the entire device is mounted on an adjustable platform, tilted to the proper angle for facilitating diagnosis.

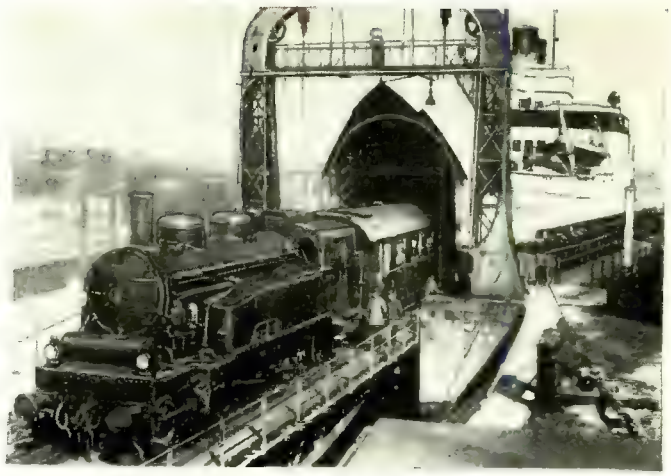
Guarding Persia's Art

A THIEF stands a very slim chance at the exhibition of priceless works of art belonging to the Shahs of Persia, being held at the Royal Academy, London. Invisible guardians protect the age-old treasures.

To either side of the museum piece pictured is a pedestal. A beam of infra-red light constantly plays between these two pillars. The minute a human being intercepts the light ray the resistance of a selenium cell sealed in an evacuated bulb is so changed as to close a relay circuit. A buzzer sounds; the museum doors lock automatically.



To guard this work of art exhibited in the Royal Academy in London, a beam of invisible light constantly plays in front of it. If an arm or cane passes between the two pedestals, a buzzer sounds throughout the building and all doors are automatically locked.



To adapt the ferry ship for transporting railroad trains, a hinged forecastle was constructed. This, when raised, allows the cars to enter. It is then lowered into its usual position. A separate steam engine located beneath the main deck, which carries the train, furnishes the power for the operation.

Tracks Across the Seas

LIKE a giant monster, opening jaws to devour its prey, the German deep sea ferry ship, *Schwerin*, lifts the upper part of its bow to receive whole railroad trains. For some time the paddle-steamers which had served traffic between Warnemünde in Germany and Gjedser in Denmark had proved insufficient. In winter time, especially when there was ice, traffic had required at least two ferry boats. So the German Federal Railroads company decided to build a new ferry ship, constructed so as to receive its load of railroad cars over the afterdeck as well as the bow.

A hinged forecastle, a bow rudder and special bridge, used while traveling astern, were provided. Both stem and stern were designed as ice-breakers to destroy ice floes which might form at the narrow entrance of the harbors.

Of the two tracks on the main deck, the length available for placing railroad cars is 525 feet, accommodating 18 to 20 2-axle trucks, or seven 4-axle corridor cars. The deck will hold a 20-ton load per axle.

Two triple expansion steam engines, and three steam-driven dynamos, are included in the power plant.

Creating Principles of Aviation Design

WHEN Earle E. McClary, who is standing alongside his plane, designed the craft, its odd shape perturbed him not the least bit. He was trying to build a plane that would demonstrate remarkable controllability at very low speeds; provide great visibility, immediate and positive action of the controls; and eliminate noise and vibration. So far flying tests have been successful.

Monopoly on Loving Cups?

THIS eighteen-year-old girl, Miss Loretta Turnbull, ranks with the fastest masculine speedboat pilots. She's so good that she was elected into honorary membership of the Regatta Circuit Riders' Club, of the National Men's Speedboat Racing Association. Our foremost woman outboard racing pilot recently staged an exhibition of her trophies at her home in Monrovia, California. In the three years she has been racing, Miss Turnbull has won 45 of her 50 trophies competing with men. She set a pace of 48 miles an hour for class D.

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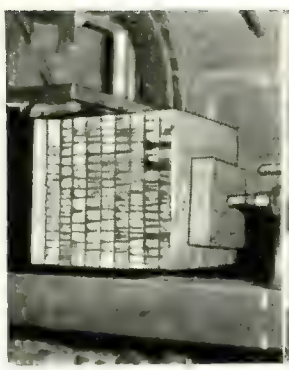

The glued block in the lathe centers.

Trim the edges of the block before turning.

The false bottom is set in this way.

Cutting the recess for the coins and bills.

The sanding wheel will give a high polish.

A Flower Pot Money Cache

Banks Are Usually Made of Cement and Steel and Stone. Here Is One You Can Make on Your Lathe and That Will Adorn Your Home

By John Horndale

THE fun of hoarding pennies and nickels and quarters appeals to all of us—young or old. It's a mighty thrifty idea to encourage with the youngsters, too. Not that we want them to get the idea that a good bank isn't the place for permanent deposits, of course.

Anyway, a trick cache like the one shown appeals to the growing boy or girl because the secret compartment is so well camouflaged they take a delight in using it. Here we have obviously a pot of imitation flowers. But who would guess what else the pot contained?

In substance, the project consists of a block of wood, original size, 7 inches square and 7 inches high. This is glued up right in the shop by spreading best quality liquid glue over the squares of wood, then setting them between the lathe centers, screwing up the dead center and leaving it over a night and day for the glue to thoroughly dry. Then this piece is turned down to the dimensions shown, a false bottom put in, and the artificial flowers set in plaster of paris with which a bit of lamp black has been thoroughly mixed to resemble rich earth. This is placed in the shallow top and will not come out.

The prettiest bank you ever saw.

To further the deception felt is lightly glued to the outer rim of the bottom, and a slit made through this to coincide with the slot in the false bottom through which the coins or paper money are deposited. When the bank has acquired a small fortune the felt is stripped from the bottom. This exposes the screws which can be readily removed, and the bank's contents removed. It takes but a moment to replace it, reglue the felt back in place and the bank then becomes available for another cargo of coins.

Sap gum was the wood used for the cache shown. The squares were sawed from a board 7 inches wide and ¾ of an inch thick, with the grain running the same way in all pieces. This lessens the impression that the job is a glued-up affair.

After turning the piece down to round, to a 6-inch diameter, first turn, at the tail stock end, the ¾ inch deep recess in the pot top. To insure maintaining the true center, it will pay to make a small drill hole 1½ inches deep in this end not over 1/32 of an inch in diameter, if possible. Then, when the recess is cut, the turning can be reversed in the lathe and the same center used without turning

(*Continued on page* 69)

Six small screws hold the plywood false bottom in place.

Plaster of Paris mixed with lamp black forms the earth for our flower pot.

Sanding and rubbing with fine steel wool will remove all roughness.

Bore a shallow hole in the top of your pot for each flower stalk.

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Scientific Aids to Your Comfort

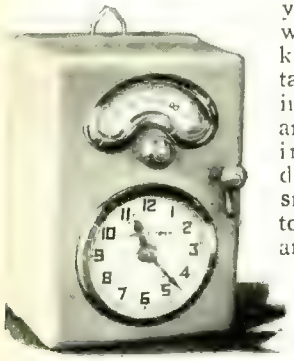
By Mary Jacobs

You need not use the device as an interval timer only. In addition, it is a good clock. It may be suspended by a loop or may stand on its base. You may choose ivory, green or gray enamel. Tested and approved in our laboratory.

All the Drip Is in the Tub

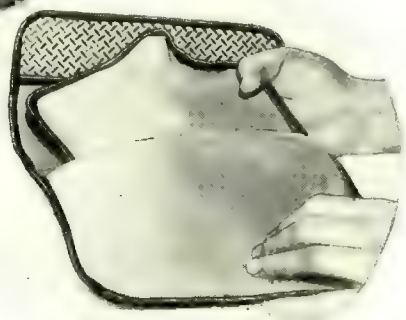
ARE you one of the legion of women who washes her stockings, silk underthings, handkerchiefs and blouse in the bathroom just before going to bed? And, incidentally invites a cold by exposing herself to the chilly air at the window, in hanging garments outside. Even if you are fortunate enough to have a drying rack in the kitchen, it's rather a nuisance to walk to that room and adjust the dryer.

Should you wash baby's garments during the day, it's no fun to have them dripping over you as you work in the kitchen, simultaneously ruining its appearance. A folding clothes dryer that fits snugly over the top edges of any standard sized bath tub will banish these inconveniences. 27 feet of rust-proof line is provided. The tub dryer may be folded up and stored away. Tested and approved in our laboratory.



Don't Let Yourself Forget

HAVE you ever used an alarm clock to time the baking of a pie, or the cooking of vegetables? No? Well, its use might have saved many a burnt dish and enabled you to leave the kitchen with an easy mind to answer the doorbell, make a phone call or receive a caller. When minutes count, the illustrated interval timer and alarm clock combination will prove a blessing. Set it at any point up to 90 minutes, by turning a knob. A glance will tell you how much of the allotted time has elapsed. At the end of this period, a bell will ring.



This Pad Warms Itself

WHEN Admiral Byrd made his famous North Pole flight, he took with him one of the warmers pictured above. Why? It heats itself; neither a stove to boil water, nor electric current is required. All one does is insert three tablespoons of water in the inner pocket, and shake. The longer you shake the hotter it gets. When at the desired temperature, replace it in the rubberized cover, and use *for as long as needed.* We tested it for a few hours, during which time it maintained a fairly constant temperature. Of course, repeated use will finally wear out the chemical filler, which is replaceable. Tested and approved in our laboratory.

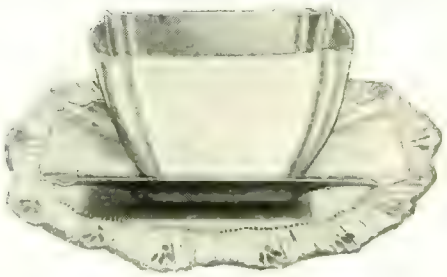
Turn on the Heat and Humidity

PERHAPS you've noticed that colds, flu and grip are most prevalent during the seasons when heating of the home and office are necessary. These diseases may be partially attributed to the fact that the average heating system dehydrates the air, making a room dryer than the Sahara Desert or Death Valley.

Here's an electric heater that returns moisture to the air while heating the room. Also, dust and germs in the air are burnt up, so that the air it delivers is purer than when it entered. Combustion is so complete that no flue or vent is required to remove gases. On spring days it will take the chill from cold porches; in the winter, it will heat rooms (the product circulates over 6,000 feet of cubic air). And you need not be ashamed of its appearance—it looks like a decorative cabinet. Since the outside remains cool at all times, you may use the heater as an extra seat or shelf for flowers and books. Tested and approved in our laboratory.

For Frozen Desserts

THE dainty sherbet or colorful ice you serve after dinner will appear doubly appetizing in these gleaming silver cups and plates, in which, of course, it was frozen. This dessert service consists of four deep dishes or cups, and four plates, each large enough to hold an individual portion. They are designed in a simple, modern pattern, plated with pure silver, satin gloss finish on an 18 per cent nickel silver base. Tested and approved in our laboratory.



So That Silver Keeps Its Lustre

POLISHING silverware is a tiresome job isn't it? No matter how much attention you give your knives, forks and spoons, some always need to be cleaned

(*Continued on page 77*)

Names and Addresses of All Manufacturers Will Be Supplied Upon Request

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Cosmic Bullets

Are the Cosmic Radiations Originating in Interstellar Space the Death Rattle of the Atom or the Birth Cry of a New Particle?

By Donald H. Menzel, Ph.D.

Lick Observatory, Mount Hamilton, Cal.

Fig. 1—A human electroscope. The similarly electrically charged hairs repel each other.

WE live in the midst of a great battle field. Every minute of the day and night we are subjected to a terrific bombardment. Several thousand tiny bullets, not just skin-pricking darts, but high-power projectiles, penetrate our bodies every second. These facts are all the more amazing when we recall how utterly unconscious we are of the existence of this devastating fire.

The first suspicion that projectiles or rays of great penetrating power were actually striking the surface of the earth came as the result of a very simple experiment. Anyone who has studied high-school physics will recall his experiments with an electroscope. The instrument consists of a piece of gold leaf hung over a bent wire, as shown in Fig. 2. The glass container provides support, insulation and protection. Now, when any body charged electrically, *e.g.*, a stick of sealing wax that has been rubbed with fur, is brought near the one end of the wire, an electric charge is *induced* in the opposite end. Because the two halves of the gold leaf will be similarly charged, they will repel one another, with the result pictured in the right hand figure of the illustration.

We have all experienced occasional difficulty in combing our hair on those days when a spark snaps from our finger as we touch a metallic surface. We say "there is electricity in the air" when our locks stick to the comb and stand on end. The truth is that we have become "human electroscopes"; rubbing with the comb has created static electricity and our individual hairs, charged with electricity of the same kind, repel one another and stand out like the gold leaves of the laboratory electroscope.

Neither the gold leaves nor our hair (fortunately) will stand out indefinitely. Somehow or other the electricity gradually leaks away and the condition returns to normal. The discharge of the electroscope is almost instantaneous when a grounded copper wire is touched to it. If the instrument is left to itself, however, the electricity must escape into the air, a bad conductor, and the rate of discharge is slow. It would not escape at all if there were no "electricity in the air." In 1903 Sir Ernest Rutherford and J. C. McLennan, famous physicists, discovered that, if the electroscope were encased in a metal box, the rate of leakage of the electric charge could be reduced. This meant, of course, that the air inside the box was less electrified than the air outside, which suggested that atmospheric electrification is caused by some external influence, perhaps a penetrating form of radiation, that was only partially screened by the walls of the box.

To test the soundness of this view, Gockel (1910-11), Hess and Kolhörster (1900-14), and Millikan and Bowen (1922) sent electroscopes up in balloons, to record the electric state of the upper atmosphere. If the hypothetical rays were coming from interstellar space, we should expect them to increase in intensity at high levels, since they would have to go through less material before reaching the electroscope. Millikan and Bowen sent balloons up as high as ten miles. The results of these experiments were entirely in accord with theory.

Next Millikan and his collaborators tried sinking their electroscopes in the depths of lakes, where they found, as expected, slower rates of discharge the deeper they sank the instruments. They were careful to choose lakes where the water comes directly from melting snows. Spring water, during its passage

(*Continued on page 80*)

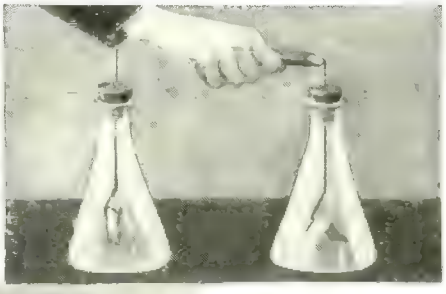

Fig. 2—The electroscope to the left has been discharged and the two halves of the gold leaf hang down. Right—the electroscope can be charged by touching it with a stick of electrified sealing wax. The leaves then repel each other.

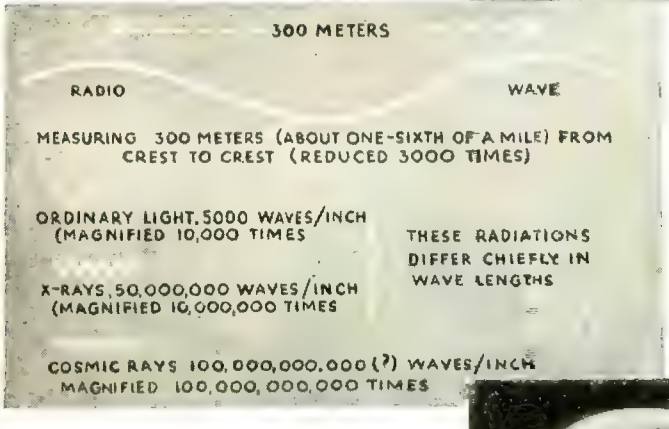
300 METERS
RADIO
WAVE
MEASURING 300 METERS (ABOUT ONE-SIXTH OF A MILE) FROM CREST TO CREST (REDUCED 3000 TIMES)
ORDINARY LIGHT, 5000 WAVES/INCH (MAGNIFIED 10,000 TIMES
THESE RADIATIONS DIFFER CHIEFLY IN WAVE LENGTHS
X-RAYS, 50,000,000 WAVES/INCH (MAGNIFIED 10,000,000 TIMES
COSMIC RAYS 100,000,000,000 (?) WAVES/INCH MAGNIFIED 100,000,000,000 TIMES

Fig. 3—Comparison of the wave lengths of various radiations. Radio waves are the longest, cosmic the shortest.

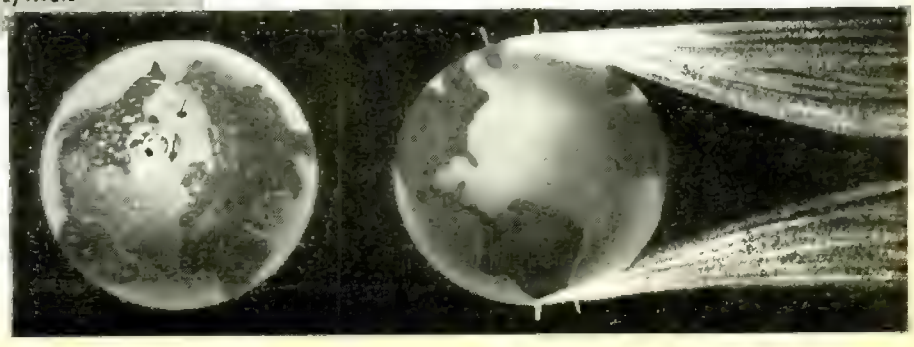

Fig. 4—If the cosmic rays were composed of high-speed electrons, they would be deflected by the Earth's magnetic field and strike in greater numbers near the magnetic poles.

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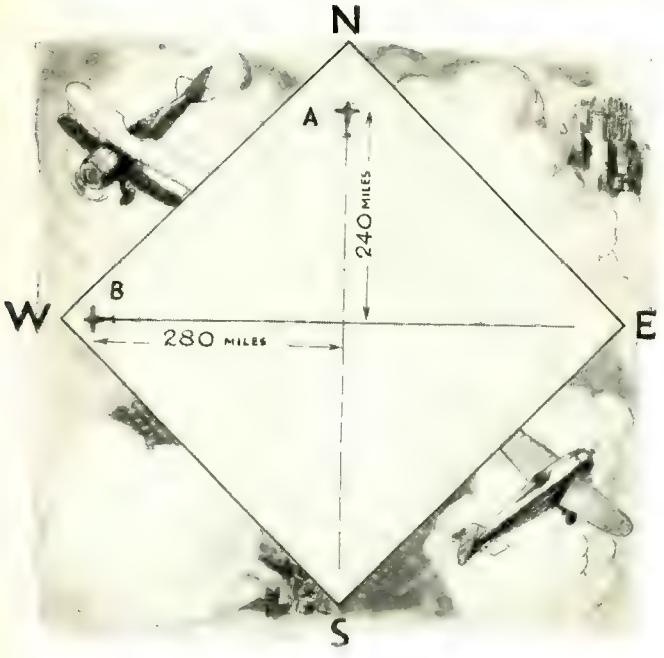
Prize Puzzles to Polish Your Wits

By Sam Loyd

THE Puzzle King presents the seventeenth of a series of problems, the solving of which will show if your mathematical ability is bolstered up by logical reasoning. Prize winners of the February puzzles and solutions will be found on page 87.



At What Time Were the Mail Flyers Closest?

TWO mail flyers started from north and west simultaneously. Andy going from north to south at the rate of 128 miles per hour, and Bill from west to east at the rate of 96 miles per hour.

From Bill's western starting point to the point where their routes crossed at right angles, the distance was 280 miles. Andy's starting point was 240 miles north of the point where their air paths crossed.

If they started their flights at 12 o'clock, noon, and traveled at their respective top speeds for three hours, and at the same altitude, at what time were the flyers closest together?

Twenty-Five Dollars in Prizes

A FIRST PRIZE of $10 will be awarded to the persons sending correct answers to the three puzzles accompanied by the best expressed analysis of the Flying the Mail Problem.

A SECOND PRIZE of $5 will be awarded for the next best analysis and correct answers to the three puzzles.

TEN PRIZES of $1 each will be awarded to the ten persons who send the next best analyses of the Flying the Mail Problem together with correct answers to the three puzzles.

Answers must be received not later than noon, May 16, addressed to "Puzzle Editor," SCIENCE AND INVENTION, 381 Fourth Avenue, New York City.

All contestants must abide by the decisions of Sam Loyd, who will examine all papers and award the prizes.

Papers of identical merit, tying for any one of the prizes, will each receive the full amount of the prize tied for.

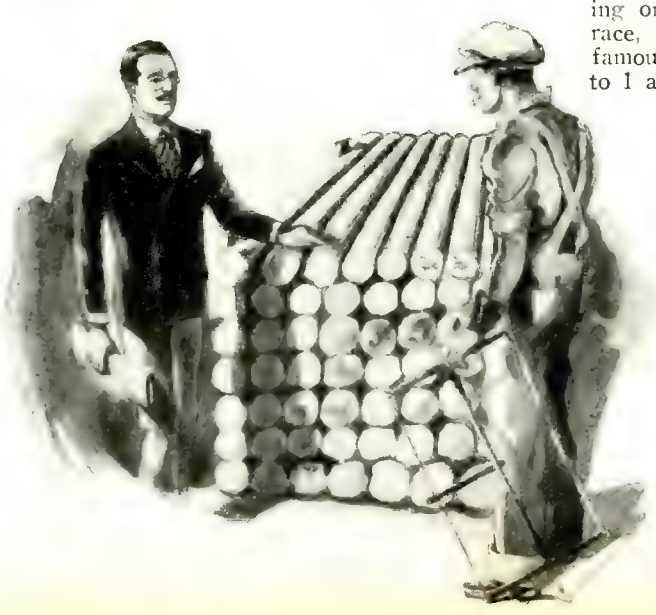
A Puzzle in the Woodpile

I ENGAGED an itinerant handy man to saw up a cord of soft wood into 16-inch lengths. He was a methodical fellow, and after figuring up his time at so much per hour, he charged two dollars and forty cents for the job.

Then I turned him loose on a cord of hard logs, at the same rate per hour for his labor. These he also cut into 16-inch pieces, but the hard logs were eight feet long, whereas the soft logs were only four feet.

Figuring up his time for that second cord, we found he was entitled to an even dozen dollars for it, and that set me to calculating how much longer it takes to saw through hickory than pine.

If the man sawed through a soft log in three minutes, how long did it take him to saw through a hard one, based upon the given data, and assuming that the logs are of the same diameter?



New York's First Air Derby

HOW many remember the exciting Air Derby which took place in New York City some score of years ago? The endurance record was then a matter of hours, and the Derby course, which started and ended at Hempstead Plains, Long Island, and included the circling of Liberty Statue, represented about the limit of daring in air travel.

If I remember rightly, the Englishman, Graham White, was victorious against his two competitors.

There was much wagering on the outcome of the race, and Sol Lichtenstein, famous bookmaker, laid 20 to 1 against a perfect forecast of the result. There was, of course, the likelihood of one or more of the entrants not finishing as well as the possibilities of dead-heats, and these contingencies had to be taken into consideration in venturing your prediction. It makes quite an interesting problem. Three planes started, and the question is—In how many varied ways could the race terminate?

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For Real Sport—Try Archery

This Article Gives Complete Information for the Construction of a Bow and Arrow Including Details for Making the Target

By Charles Herbert Alder

NEARLY everyone at one time or another has hunted with a shotgun or rifle and enjoyed the sport. But—have you ever stalked and brought down game with a bow and arrow? No? Then you've missed a thrill. Bringing home the bacon with the aid of a rifle is not as easy as with the use of a shotgun, providing of course that the game is a bird on the wing or a rabbit on the run. Yet you get far more satisfaction out of the sport when you know that the quarry has an even chance of getting away, so that when you do bring down your prey— Well, sir—it's a "grand and glorious feeling." This ecstatic feeling is doubled and tripled when your weapon is a bow and set of arrows. You feel proud, and justly so, for it takes skill and a great deal of shrewdness to succeed in the hunt—far more than is needed with a rifle or shotgun.

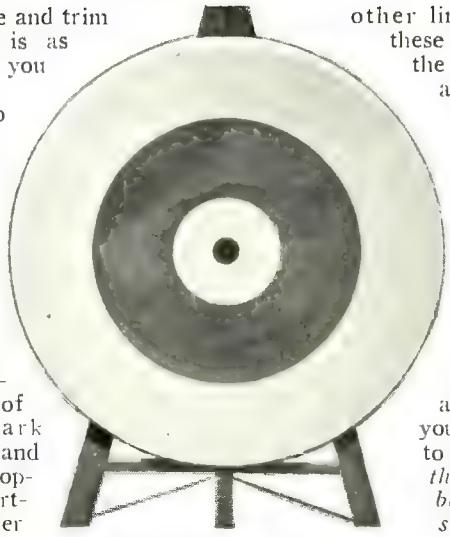
It's great sport and you'll enjoy it. You have to be just a little bit more wily than the game you're stalking and that adds zest. It then becomes a game of wits and pure skill with the bow.

Make this archery outfit, practice shooting at the target—then go out and bring home wild game!

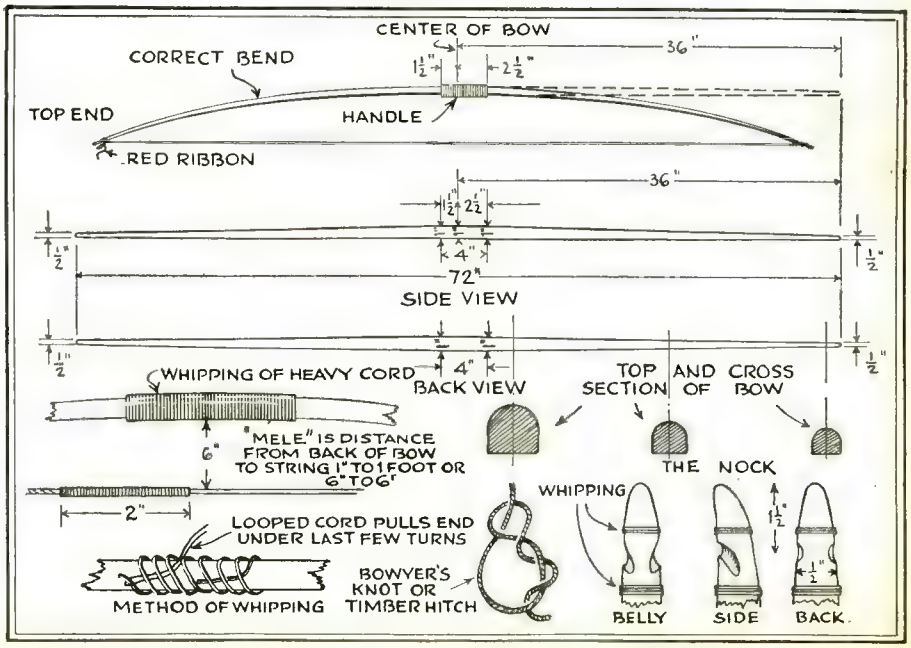
When bows and arrows were man's best weapons, a bow with a 150-lb. pull was not uncommon, but nowadays men have no need for such a powerful bow. Archery is now practiced merely for the sport. When hunting animals such as deer, you'll find a 50-lb. pull in a bow to be ample. If you are not strong enough to manage a bow as powerful as the one described, scrape and trim your bow until it is as weak or as strong as you want it.

The first thing to do is to procure a piece of wood as long or a little longer than you are tall by 1″ to 1¼″ square. Mark off the middle of the bow with two lines, one running lengthwise and the other running crosswise. On one side of the crosswise mark measure off 1½″ and make a line. In the opposite direction, starting from the center line, measure off 2½″ and make another line. Working from these two lines, trim down the stave on both sides and the belly of the bow with a plane to one-half the thickness of the bow at the middle or handle. If your bow is one inch in thickness at the handle, make it one-half inch wide and one-half inch thick at the ends. If it is 1¼″ square at the handle, taper your bow at both ends to ⅝″. *Do not do anything to the back of the bow except plane it smooth and sandpaper*

(*Continued on page 76*)



The target mounted on an easel. Below—Details of the bow.



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Those Artistic Russian Candlesticks

This Russian beau and his lady look lifelike enough to step off into a lively mazurka.

This is how the figures will look just after you've shaped and painted them.

These Candlesticks Will Lend a Bright Touch to the Table, Mantelpiece, or Boudoir, and Can Be Readily Turned on a Wood Lathe

By Edwin T. Hamilton

FROM far off Russia—that cold and fascinating land of candles—come these quaint candlesticks, which are a pleasing addition to milady's dining table, or a charming and interesting ornament for a mantel or window.

They are simple to make for the man who has a lathe at his command. The only additional tools necessary are a brace and bit. The candlesticks are made in two parts—the figure and base. The most difficult part is their painting, and if instructions are followed carefully this should offer no trouble to the careful craftsman.

For clarity, let us go through the process of building one of the four designs given. Then the work of fashioning the others will be easily understood. For construction purposes, therefore, we will make candlestick No. 1.

Obtain a block either 1½" square, or round and of the same diameter, and cut it 5 7/16" long. If a square block has been used, turn it up on your lathe to the same diameter. Remove from the lathe, and with a ⅝" bit, bore a hole in its end ⅝" deep. Mark in pencil on the length of the block, starting from the end just bored to indicate the points at which the various diameters start and finish, such as the hat, head, coat, trousers, standard, and the peg. Put the block back in the lathe, and turn it slowly, while holding the pencil against each of the marks just made, so that the marks will extend around the block. You are now ready to cut the block to form. If marked properly, the marks should measure from the bored end ⅝", 1/16", ⅛", ⅝", ⅞", ⅞", 1½", ¼", and ½", which is the length or height of the figure. Check them back carefully.

You don't need any other light illuminating your table at night. A few of these candlesticks, holding bright candles, will provide sufficient light, and add warmth and decoration to any room.

The form of the man is now cut. Do not cut the figure down to the desired diameter, but leave about 1/16" over, which is finished off with sanding. Do this work while the figure is in the lathe. The base is now cut from a 3¼" inch diameter piece of stock. When finished, remove it and bore a ¼" hole through its center with a brace and bit making sure that it is perpendicular. The peg of the figure is to be coated with glue, and thrust into this hole until it rests tightly against the top of the base. When thoroughly dry, the candlestick is ready to be painted.

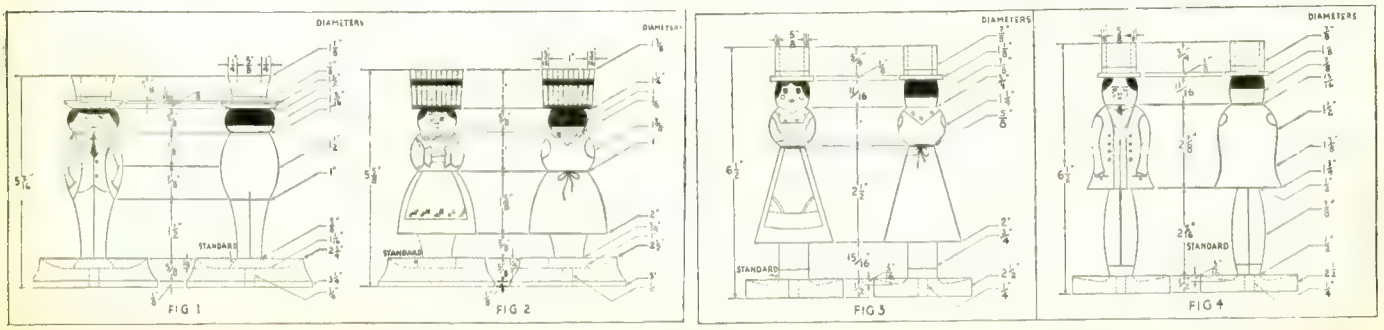
Four different figures are provided, but if the builder wishes six or eight candlesticks their appearance may be easily changed by painting various colored clothes on them. For this purpose, two color schemes are given for each figure. The vivid blending of colors denotes Russia in her most festive mood. Those not understanding the Russian costumes should follow the color chart carefully.

All outlines of coats, shirts, trousers, vests, etc., are in heavy black lines. The small circles in the cheeks are not outlines, but merely show the location where the cheeks are reddened.

When the painting of the figures has been completed, thin pads of green felt should be glued to the bottom of the base, so that the finest finished table cannot be scratched by them. When the paint is thoroughly dry, the builder should judge as to whether the figures need a second coat or not. If so, apply, and then, when dry, give the entire figure and base a coat of clear varnish. While the painting of the candlesticks is by far the most difficult job, the builder should experience little or no trouble if the photos and the color charts are followed carefully.

These candlesticks will be sure to provoke comments from guests.

It may be advisable to ballast them with lead, poured into holes in the lower parts of the bases. (*Cont'd on page* 83)



Slabs of wood, a lathe, a brace and bit and some paint and brushes are all the tools and materials needed to make any or all of these interesting Russian figured candlesticks. Follow the text for colorings, unless you'd prefer to be original.

www.americanradiohistory.com

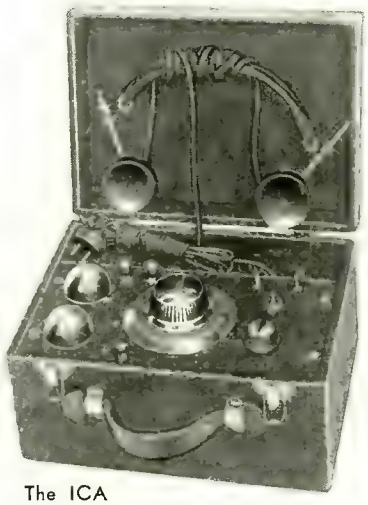
What's New in Radio

An Individual Radio Set

FOR those who would enjoy their radio programs anywhere, at any time and without interference to or from others in the same room or home, the ICA Companion comes to solve the problem of *individual reception*. It is a self-contained, portable A.C. receiver for head-phone reception, serving a distinct function quite untouched by the standard and midget sets heretofore available.

The ICA Companion is a two-tube A.C. receiver employing two -27 type tubes, one as a detector and the other as a rectifier. No batteries of any kind are required, it being necessary only to plug into the nearest 110-volt socket or receptacle and to make use of any available antenna or ground connection for immediate operation. The tuning comprises the tuner and a sensitivity control, both being manipulated for maximum response from any desired signal. Three binding posts are provided for "broad," "sharp" and "local" reception conditions, using either an antenna or a ground connection, only one being required. The head-phone reception is of a clarity and volume that will be found agreeably pleasant. The range of this receiver will be found comparable with that of the usual loud-speaker broadcast receiver.

The ICA Companion, with tubes and head-phones complete, is entirely self-contained in an attractive miniature suit-case, measuring only 13 × 14 × 7½ inches and weighing but 10 pounds.



The ICA Companion

New Jewell Test Oscillator

A PORTABLE test oscillator has been added to the line of radio servicing equipment manufactured by the Jewell Electrical Instrument Company.

This instrument provides the radio serviceman with a means for making quick and accurate service adjustments. Aligning gang condensers, locating shorted r. f. coils, "peaking" or "flat topping" intermediate frequency stages, adjusting the oscillator stage of superheterodyne receivers, and making comparative gain tests with a standard set are some of the frequent service jobs for which the test oscillator is used.

Servicemen find the easily controlled signal from a test oscillator enables them to make more accurate adjustments on radio receivers. It is also known that the human ear is insensible to small differences in signal strength that mean important changes in sensitivity. By using an output meter, a visual indication of signal strength is secured that makes accurate adjustment less difficult.

Selection of either intermediate or broadcast frequency band is made with a single switch.

Direct-Reading Ohmmeter Scales for Milliammeters

IN order to convert the usual O-1 milliammeter into a direct-reading ohmmeter, the International Resistance Co. has prepared special ohmmeter scales applicable to Weston meter Model 301 and Jewell meter Pattern 88. The scales indicate both milliamperes and ohmmage readings and may be pasted directly over the usual milliampere scale. The scale in ohms refers to a battery voltage of 1½ volts and a calibrating resistance of 1,500 ohms. The resistance range may be increased by the use of other calibrating resistances and battery voltages indicated on a table supplied with the scales, the scale then being multiplied by the factor indicated. Thus the maximum range of the ohmmeter may be increased up to 750,000 ohms, if desired, by the appropriate calibrating resistance and battery voltage. The scales and data will be sent without charge to anyone on request.

Westinghouse "Columaire" Radio

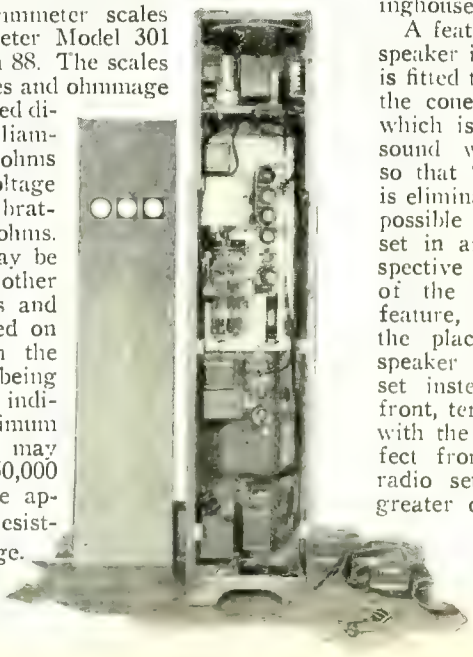
THE "Columaire," a novel radio receiving set in a slim vertical cabinet is a revolutionary departure in the radio industry. Occupying a very small floor area, 10 × 12 inches, this vertical radio cabinet, which is 59 inches high, will fit in corners or flat against the wall. It is particularly adapted to small apartments.

The unusual name of the set, "Columaire," comes from the fact that the speaker is mounted on top of the cabinet, pointing upward, and there is a five-foot column of air under it. All controls and dials are flush-mounted on the sides of the instrument and are readily usable from a standing or sitting position. The circuit in this set is a nine-tube, screen-grid superheterodyne with tone control.

The back of the cabinet is easily removable for the replacement of tubes or servicing the set and the vertical chassis makes these operations unusually simple.

Another innovation is the inclusion on the front face of the set of a Westinghouse electric clock.

A feature of the loud speaker is a plug which is fitted to the center of the cone, the effect of which is to spread the sound waves laterally so that "ceiling effect" is eliminated. It is thus possible to install the set in any room, irrespective of the height of the ceiling. This feature, together with the placement of the speaker on top of the set instead of on the front, tends to do away with the directional effect from which most radio sets suffer to a greater or less degree.



Rear view of the "Columaire" radio, with back removed.

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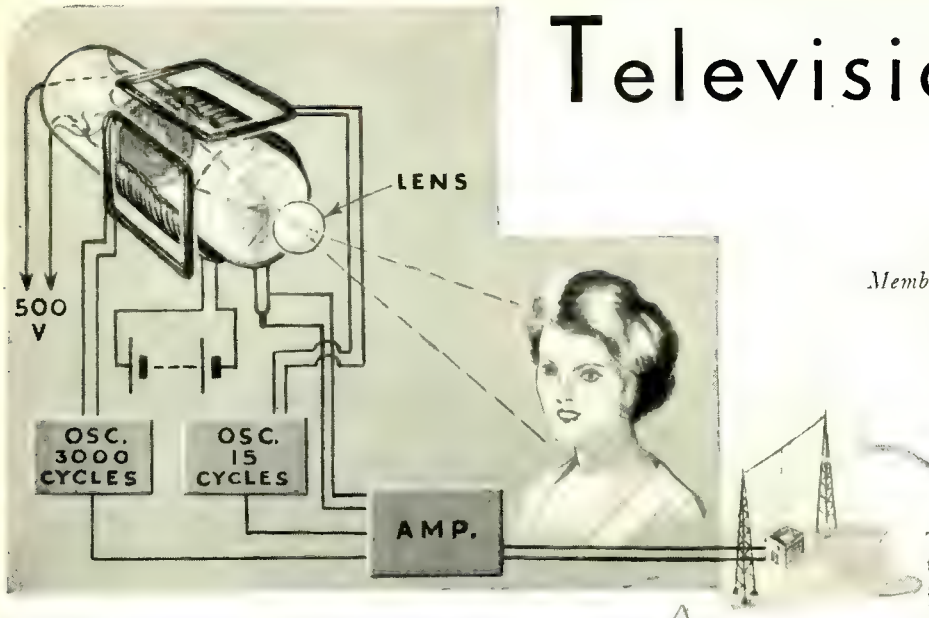
Television Takes

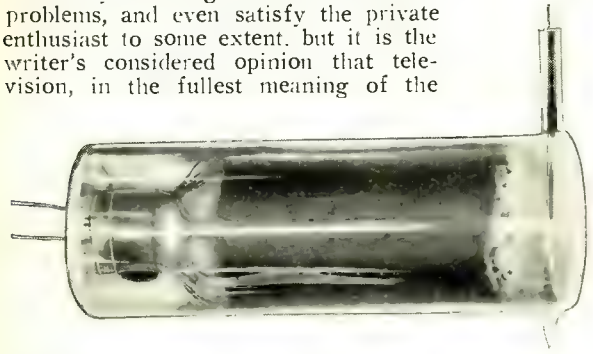
By
A. Dinsdale
Member of Council, Television Society, London.

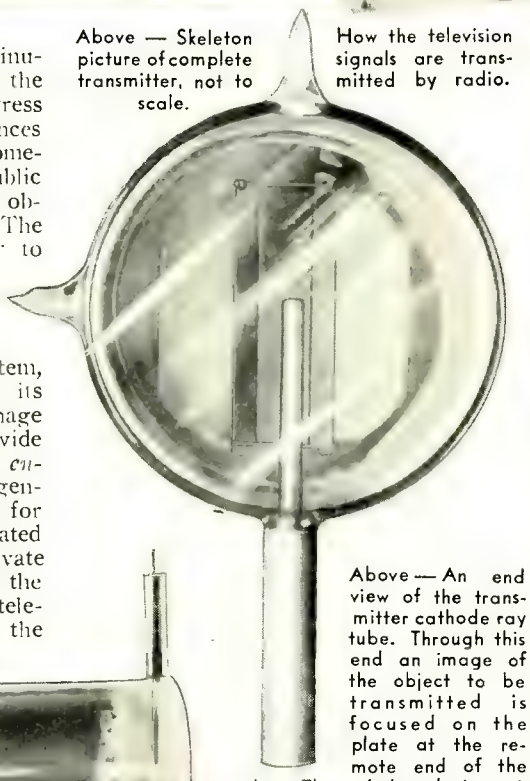


Above — Skeleton picture of complete transmitter, not to scale.

How the television signals are transmitted by radio.

ALTHOUGH television is continually receiving attention in the Press—accounts of progress here and there, or visionary references to the part which it will play sometime in the future—the general public is only passively interested. It is obviously waiting for something. The reason for this attitude is not far to seek. Originally heralded three or four years ago amid much ballyhoo, television has so far failed to live up to expectations. The Nipkow disc and neon tube system, although simple, has demonstrated its complete inability to provide an image sufficient in scope and detail to provide what the public demands, which is *entertainment*. Mechanical methods generally, provide excellent material for laboratory investigations into related problems, and even satisfy the private enthusiast to some extent, but it is the writer's considered opinion that television, in the fullest meaning of the public's expectations will never reach maturity by the mechanical route.

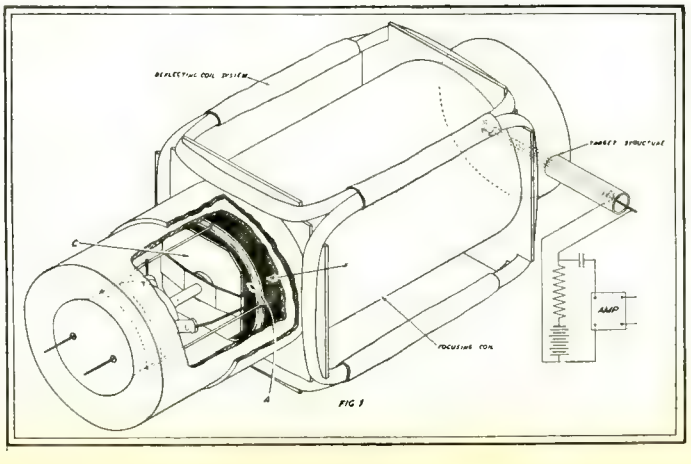




Above — An end view of the transmitter cathode ray tube. Through this end an image of the object to be transmitted is focused on the plate at the remote end of the tube. The tubular device at the near end of the tube is the photoelectric cell. Left—Side view of the transmitting tube. Below—Complete drawing of tube and coils.

The only alternative method so far developed involves the use of cathode rays which, being composed of weightless electrons moving at speeds rapidly being brought close to that of light, possess sufficient speed and inertia to conform to the enormously high scanning speeds necessary to the full realization of television.

The latest investigator to employ cathode rays in his television researches is Philo T. Farnsworth, of Television Laboratories, Inc., San Francisco, and the results which he has so far achieved, and his methods of achieving them, impress the writer as being probably the most important contribution to the art to be revealed to date.



A cathode ray tube is essentially similar to the vacuum tubes used in every radio set, and is usually shaped as shown in Fig. 5. Within the narrow end of the tube, which is highly evacuated, there is a filament mounted in the interior of a small cylinder. Electrons emitted by the filament pass through a tiny orifice in a metal plate, or through a small diameter tube, placed close to the opening of the filament crater.

The plate or tube, called the anode, is energized from a high voltage supply of several thousand volts. The net result is that a thin pencil of electrons is projected into the expanding part of the tube, and impinges on a fluorescent surface or screen which coats the inner wall of the wide end of the tube. This fluorescent screen makes the rays visible to the eye.

Between the filament and the highly charged anode there is often placed a control grid, similar to the grid of a radio tube. When varying voltages are impressed on this grid the intensity of the electron or cathode ray stream is varied proportionately. Such a pencil of cathode rays can be moved to and fro by either magnetic or electrostatic means, and since the rays have no inertia, their response to any deflecting influence is virtually instantaneous.

Cathode ray tubes are used commercially for a variety of purposes. For example, it is usual to employ them as oscillographs to render visible the wave forms of the oscillations set up by the human voice or other agency. The exact form and design of the tubes vary according to the purpose for which they are intended.

Farnsworth uses cathode ray tubes for both transmission and reception, the form of transmitting tube (called by him an image dissector

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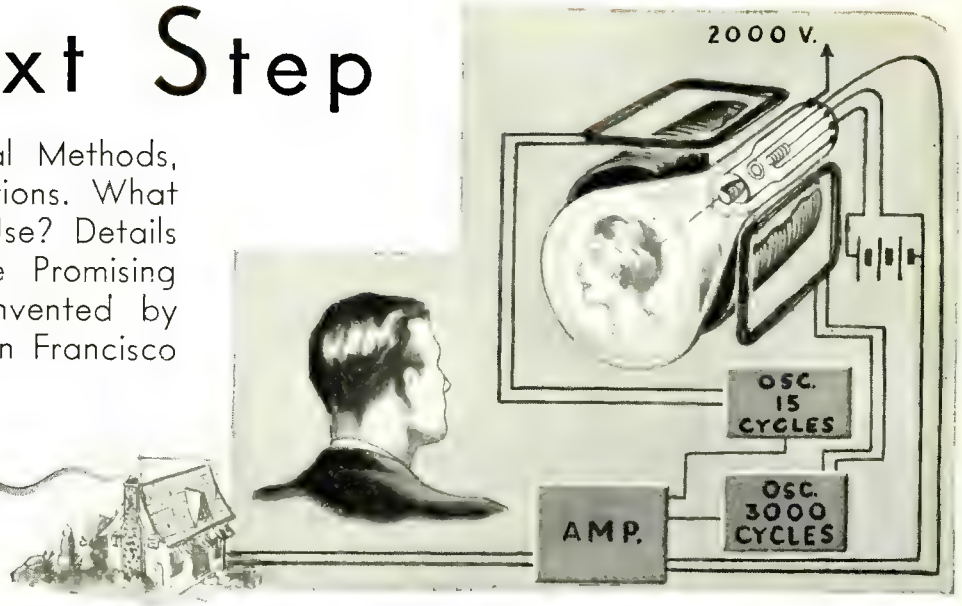
The Next Step

Television, by Mechanical Methods, Has Many Definite Limitations. What Other Method Shall We Use? Details Are Given Here of the Promising Cathode Ray System Invented by Philo T. Farnsworth of San Francisco

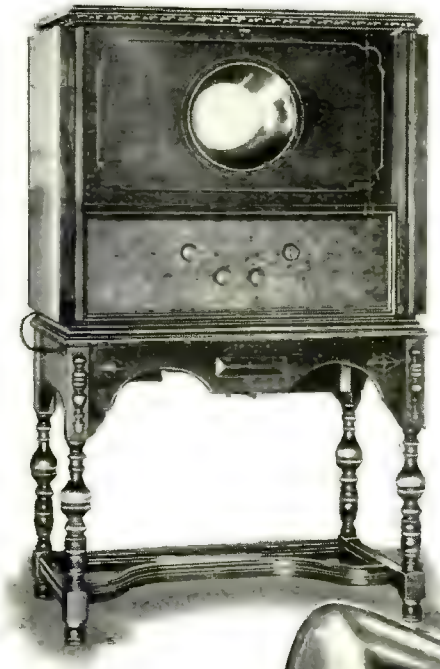


tube) being shown diagrammatically in Figs. 1 and 2, and in one of the accompanying photographs. The tube, which is of the cold cathode, high vacuum type, consists of a cylindrical glass tube, having at one end a flat window which is polished before sealing in. At the other end is a stem upon which the elements of the tube are supported, and through which the leads pass. The inner end of the stem carries a short glass pillar which ends in a square button, C, Fig. 2. This button supports a silvered mirror upon which is deposited a photosensitive film. A band clamp supported by the stem carries the anode structure.

This anode structure is made by winding a very fine tungsten wire around a thin flat tungsten-nickel frame, and it is supported so that it is closely parallel to the cathode. In the latest types of tubes the electrostatic shield, S, Fig. 2, consists of a platinum coating on the inner walls of the tube. At the opposite end of the tube there is a target electrode, or photoelectric cell, having all but a single small area shielded from the cathode ray discharge.

Considered broadly this tube is a form of photoelectric cell wherein provision is made for forming an "electron image" of an optical image focused on the cathode surface through the flat window opposite it. By "electron image," Farnsworth means that if a fluorescent screen were placed in the plane of the target electrode (photo cell), the original optical image would be reproduced. For this to happen it is essential that every electron emitted from any single point on the cathode surface shall impinge on a corresponding point in the plane of the electron image.

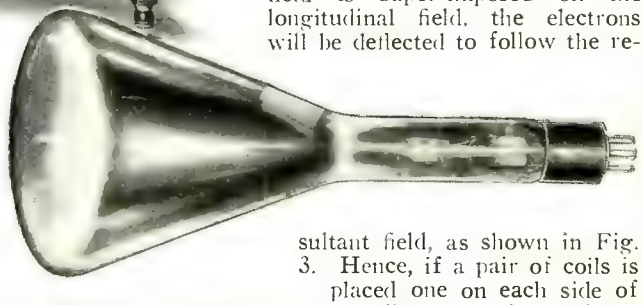
The difficulties in the way of securing a sharply focused electron image have prevented earlier investigators from obtaining successful results from the cathode ray, because of the natural tendency of the rays to "spread," but it has been found possible to focus the electrons magnetically to give an electron image which is fully comparable in sharpness to an optical image.

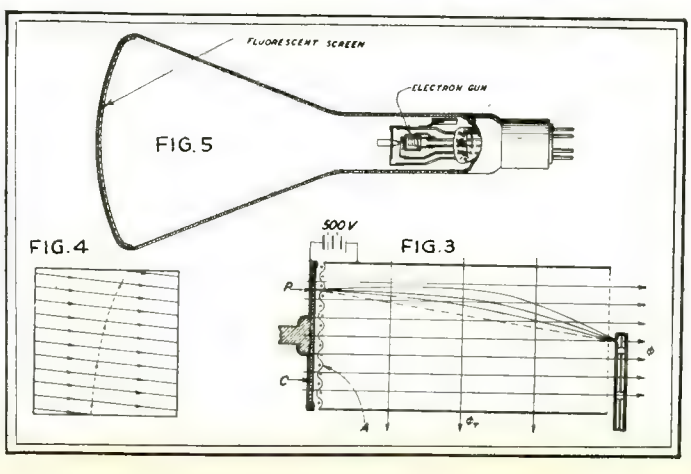


Top—Skeleton picture of complete receiver. Above—Farnsworth's television receiver, mounted in a cabinet. The circular opening is the fluorescent screen end of the receiver cathode ray tube, shown at right and in Fig. 5.

Magnetic focusing is accomplished by applying a magnetic field of the proper density in such a manner that the lines of force are parallel to the axis of the tube. The effect of this magnetic field is to bend the electrons into helical paths tangent to the line of magnetic force through the emitting point. Hence, since all the electrons start at the same point they will arrive back at the same point when they have traversed the circle once.

The axis of the helices need not be within the electron pencil, for if the longitudinal velocity is the same for all, every electron will eventually return to tangency with a line of magnetic force passing through its point of origin. Thus, if the direction of the field is changed, the point at which the rays are focused will follow the field, so that if a transverse magnetic field is super-imposed on the longitudinal field, the electrons will be deflected to follow the resultant field, as shown in Fig. 3. Hence, if a pair of coils is placed one on each side of the dissector tube, and energized with an alternating current, they will give to the electron stream a deflection along the axis of the coils, or in a direction parallel to the magnetic lines produced by them, rather than at right angles to this direction, as would be the case if there were no longitudinal focusing field.





In operation, an image of the object to be transmitted is focused through the window at the target end of the tube upon the cathode at the other end of the tube.

(*Continued on page 72*)

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MAGIC

By Dunninger*

The master mind of modern mystery, who has mystified Ex-presidents Harding, Taft, Roosevelt, Coolidge, the Prince of Wales and other celebrities, presents another of his magic series.

This Turban Changes Color

ENTER a Hindoo magician, clad in a striking costume of the East and wearing a green turban. He removes the turban from his head, unwinds it, and hands it to two assistants, also in Oriental array. They hold it at opposite ends and stretch it across the stage.

The magician holds out his hands to the audience—they are empty. He closes his fists around the turban and, beginning at one end, draws the turban through his fingers until he reaches the opposite end. The turban gradually changes in color as he runs it through his fingers, being alternately red and green.

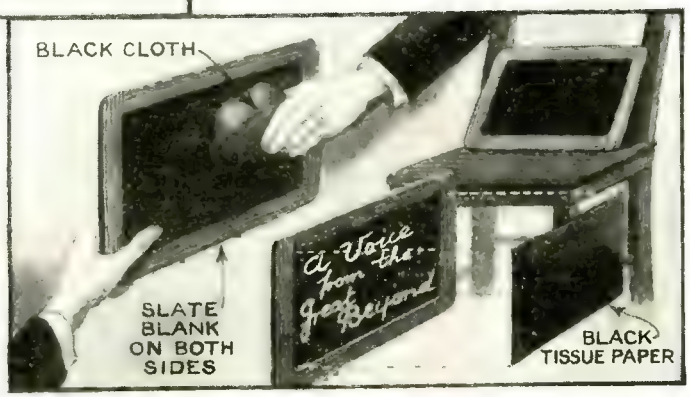
The turban is made of silk, specially woven. It is similar in texture to the color changing handkerchiefs used by many of our wizards. The sketch explains just how it is made, with the red portion on the inside; there is a green border at either side. In drawing his hands over the turban the magician really turns it inside out. He is aided by a ring which has been sewed to one end of the turban, and which he conceals inside his palm while effecting the transformation.

The Spirits Talk From the Slate

FOR producing a spirit message on a slate, try this method. You can hold up a slate to the audience; both sides will appear void of any markings. To further prove that the slate is unprepared, the magician wipes both sides of it with a cloth dampened with water from a bowl. He explains that this will eliminate any possible suspicion of the slate's being chemically treated. Rest the slate upon the back of a chair. After a few minutes turn it around. Imagine the surprise of your audience when a message will be found boldly written in white letters upon the blank side of it. Then you can pass the slate for immediate inspection.

Before presenting the trick to your audience, write a message upon one side of the slate with water-proof white paint. Allow it to dry thoroughly. Then paste a piece of black tissue paper, the exact size of the slate, on top of the message. This can be done by lightly dampening its edges with photo paste. Allow this to dry.

Now you may exhibit the slate —from a short distance it will appear quite blank. In washing the surface of the slate, use a black cloth dipped in water. This secretly absorbs the tissue paper and brings the writing to view. Of course, the prepared surface is held toward the performer and away from the audience, so as to conceal the secret removal of the tissue paper.



Sent by Air Mail

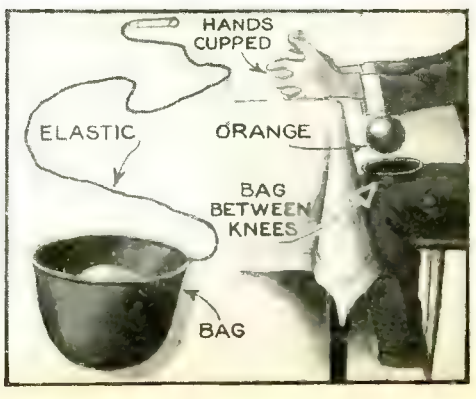
SNAPPY impromptu tricks are always in demand. Here's one that requires very little practice and prearrangement.

The performer stands at a distance of eight or ten feet from his audience. He reaches into his inside pocket and removes a letter with his right hand. He holds his left hand, fingers wide apart, about thirty inches above his right hand. Slowly the letter is seen to leave his fingers and, traveling upward through space, reach his left hand. It may immediately be passed for inspection.

A fine silk thread has been passed through two pin holes in the envelope in the manner illustrated. A small pellet of wax secures the end of the string to the envelope. Therefore, the performer has but to draw his hands slowly apart, and the envelope will pass through space. The thread can be drawn away easily after the trick has been done, so that the envelope can be inspected. The pin holes are not likely to create suspicion. As the performer is at a distance from his audience, the silk thread is invisible. The color of the thread should match the performer's costume.

The Disappearing Orange

HERE'S an interesting and effective after-dinner trick. The wizard, seated at the table, places an orange before his plate. Cupping the fruit in his hands, he (*Continued on page* 95)



No. 92 of a series of articles on magic appearing monthly

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Entertaining With Chemistry

Chemistry Is So Interesting a Subject That the Experimenter Will Find His Demonstrations Can Readily Amuse Even Those Who Do Not Care for the Technical Aspects of the Science

By Eugene Blank

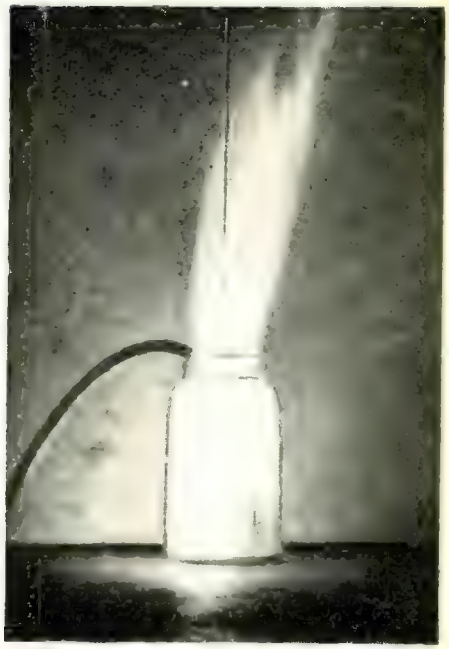


Fig. 3—Brilliant flare produced by combustion of potassium chlorate and illuminating gas.

THERE are a great number of simple chemical experiments, readily performed by the experimenter, that are at once instructive and spectacular. Here are a few good ones to perform in the laboratory for your own benefit or to amuse your visiting friends.

Zinc sulphide, as is commonly known, is a white, amorphous powder. It may be prepared in a number of ways, but probably the most interesting method is by the direct combination of the two elements, sulphur and zinc. Take several grams of zinc dust and carefully mix with an equal quantity of sulphur. Place a small pile of the prepared mixture on a metal plate or an iron ring-stand base. When the mixture is ignited by means of a lighted Bunsen burner a rapid and vigorous reaction takes place with the liberation of great clouds of white zinc oxide and zinc sulphide.

It is a common and well-known fact to the experimenter that many gases will burn in air. Under such conditions combustion is said to have taken place and we ordinarily regard the air as being the supporter of the combustion. But it is as equally possible to burn air in gas. The burning of air or oxygen in a gas is known as reciprocal combustion and may be demonstrated most readily by passing illuminating gas through a jar and introducing a deflagrating spoon of melted potassium chlorate after the gas has displaced the air.

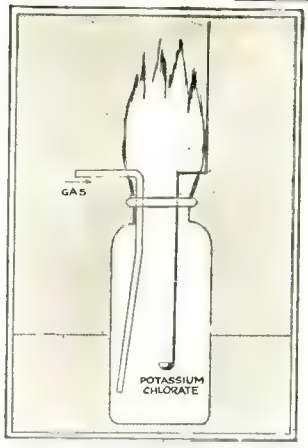


Fig. 4—"Burning" oxygen gas in illuminating gas. Melted potassium chlorate is put into illuminating gas.

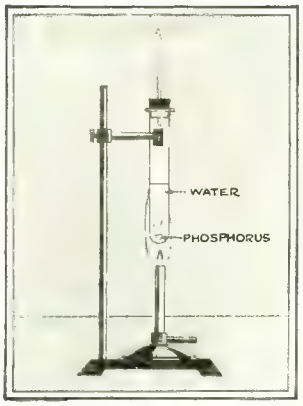
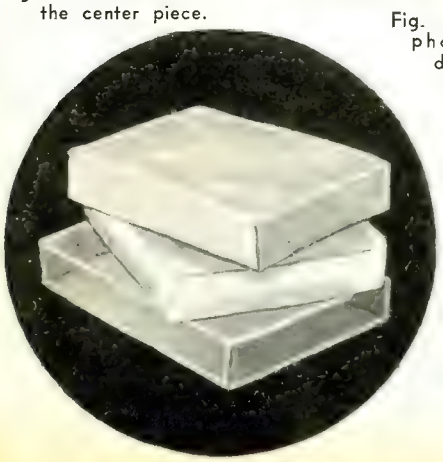


Fig. 2 — Heating phosphorus under water. The phosphorus volatilizes and a pale green phosphorescence is produced.

Fig. 1—The dyes from the two outer slabs of gelatine diffuse into the center piece.



The arrangement of apparatus for this experiment is shown in Fig. 4. Light the illuminating gas at the top of the jar and hold the spoon of potassium chlorate in the flame until it has melted and is causing vigorous combustion of the gas. Then quickly lower it into the jar of gas. A blinding illumination is produced and continues until all traces of the oxygen of the potassium chlorate are gone.

The experimenter has no doubt often burnt magnesium metal in the air. It is likewise possible to burn magnesium metal in carbon dioxide, even though the latter is commonly regarded as being a non-supporter of combustion. Ignite a strip of magnesium metal ribbon and lower it into a bottle of carbon dioxide gas conveniently obtained by the action of dilute hydrochloric acid on marble chips. The magnesium metal will burn with the formation of white magnesium oxide and the separation of the carbon of the carbon dioxide in a solid form as soot.

If a little phosphorus be placed in water and the water be boiled, phosphorus volatilizes with the steam and if the vapor should now be passed through a water-cooled condenser a luminous ring appears where the steam condenses. The phenomenon may be best observed in a darkened room. The amateur may readily perform this experiment in a simplified manner by placing a small piece of yellow phosphorus the size of a pea and a small quantity of water in a test tube fitted with a rubber stopper and a short glass tube. If the apparatus be heated till the water boils a green, luminous cloud will appear at the exit of the tube. See Fig. 2 for details of the apparatus.

A very beautiful experiment that can be performed is the production of green chromic oxide from ammonium bichromate. Sprinkle some of the latter compound on a hot plate. As each tiny particle of the salt comes in contact with the heated surface of the plate vivid scintillations occur and green chromic oxide is produced in a very pure form.

Prepare a mixture of four parts of ammonium nitrate to one part of ammonium chloride and place on a metal tray or ring stand base. Sprinkle the mixture of ammonium salts with some zinc dust. If several drops of water be added to the mixture a violent reaction takes place with the liberation of heat and in many cases with the production of a flame.

If a rapid current of air be driven through a cold concentrated solution of ammonia in (*Continued on page* 65)

How to Improve Your Camera

Any Photographic Amateur Who Is Handy With His Tools, and Who Uses a Roll-Film Camera Not Fitted With an Expensive Lens, Can, by Following These Instructions, Make Negatives as Sharp as Those Obtainable With an Expensive Anastigmat Lens

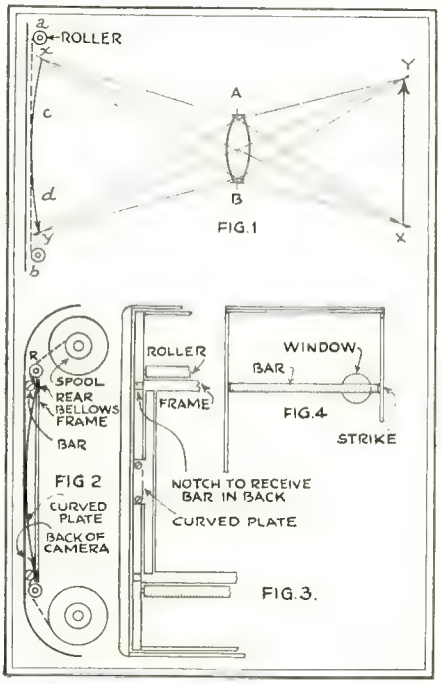
By Gordon Sproule

McGill University, Montreal

BY far the most serious optical defect for which ordinary lenses (meniscus and rapid-rectilinear) are not corrected, is "curvature of field." The effect of this is to produce an indistinct image around the edges of the negative, and particularly towards the ends of oblong shapes. This is illustrated in Figure 1. In this diagram "XY" is the subject (e. g., a landscape or building). "AB" is the lens. The curved line "xy" is the image of the subject, or "field." The solid straight line "ab" is the back of the camera, and the dotted straight line "ab" is the film, running over its rollers. It will be seen that the curved field lies (approximately) in the plane of the film only within the limits "cd," and that at the ends of the picture the rays of light coming from a point in the subject, and passing through different parts of the faulty lens, do not meet at a point on the film, but have separated a short distance, so that instead of a point we have a spot of appreciable size. Thus do nearby points overlap, and we have a blurred picture.

The great majority of roll-film cameras take pictures of oblong shape, such as the popular 2½ x 4¼" and 3¼ x 5½" sizes, and the device under discussion is particularly applicable to these. By keeping the *length* of the film in a curve approximately fitting the field of the lens the blurring of the ends will be done away with, leaving comparatively little blurring at the long edges.

This photograph, taken before the camera was "doctored," shows clearly the defective character of the lens, which produces indistinctness for some distance from the ends. Only the centre of the picture is sharply focused.



The top photograph on this page was taken with a 2½ x 4¼" roll-film camera fitted with a rapid-rectilinear lens and automatic shutter, as received from the dealer. It was taken and developed by the dealer himself "to show that the camera was all right" when the purchaser complained that it did not take good enough pictures. This picture, though well focused near the centre, is anything but clear for some distance from the ends. It would seem that the dealer had tried to avoid having detail near the ends of his picture, as it would show the defective character of the lens so badly.

The second photograph, a snapshot taken at full open diaphragm aperture, was taken with the same camera and lens after the camera had been "doctored," and the original print shows plainly the improvement to be obtained; it is clear and crisp all over. Unfortunately, much of this contrast is unavoidably lost in reproduction.

Figures 2, 3 and 4 show, respectively, a partial section of a camera with the arrangement installed, a view of the camera with the back removed, and a view of the back. On the two long sides of the rear bellows frame, that is the opening covered by the film during exposure, there are fitted curved plates of metal, as shown. The degree of curvature will be limited by the space available between the rear bellows frame and the removable back of the camera. By removing the back, focusing on a sharply defined subject, such as a leafless tree, and testing with a small piece of fine-grained ground glass, it will probably be found that this much curvature at (*Continued on page* 82)

The picture at left, taken with the same camera after simple alterations, costing nothing, had been made, shows clearly the improvement which has been effected. The detail is equally good all over the picture.

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For the Home Machinist

How to Transfer Hole Locations, to Use a Fluted Drill in the Lathe, to Make a Sliding Tool Rack, Fashion an Adjustable Grooving Tool, and Increase the Capacity of the Vise, Are Explained in This Month's Installment

By George A. Luers

Supervisor of Ordnance Design, Naval Gun Factory, Washington, D. C.

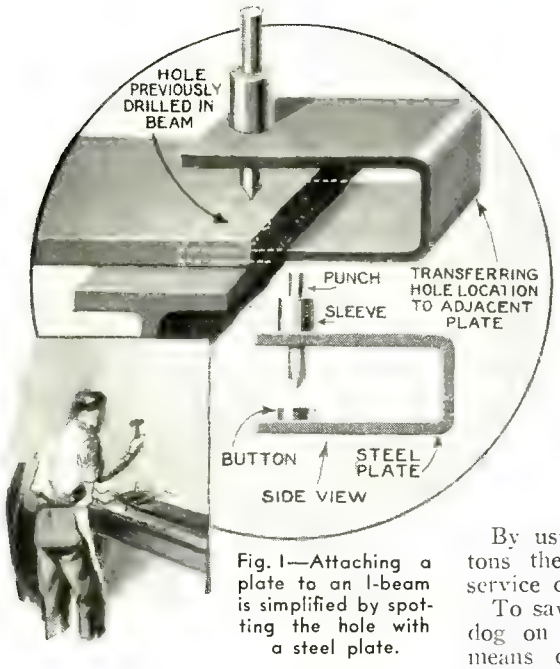

Fig. 1—Attaching a plate to an I-beam is simplified by spotting the hole with a steel plate.

IN fitting up and assembling work, it is often necessary for hole locations to be transferred to adjacent plates. This involves time and trouble in setting up materials, and measuring off your position accurately. An example of structural work in which it is necessary to attach a plate to an *I*-beam is shown in Fig. 1. The use of a simple fixture to transfer or spot the hole location without error is indicated.

The fixture consists mainly of a piece of plate bent to straddle the parts. A removable button is placed in one jaw. A bushing and punch are in the upper jaw, the locating holes being reamed and aligned in the ends of the bent plate. The button is entered in the hole, and the punch directly above on the undrilled plate, is at the center of the hole. The punch is then tapped to mark the center of the undrilled hole. The drilling of the hole can be done directly in position, without disturbing the assembling position of the plate.

By using several variable sized buttons the same fixture will prove of service on various jobs of this nature.

To save time, it is possible to place a dog on a drill and feed the tool by means of the tail stock spindle as shown in the left sketch of Fig. 2. The illustration shows the dog holding the drill, resting against a stub tool in the tool post. The tool carriage is disengaged from the lead screw and moves along with the drill. This prevents the drill from catching, when the edges break through the work, and pulling away from the tail stock center.

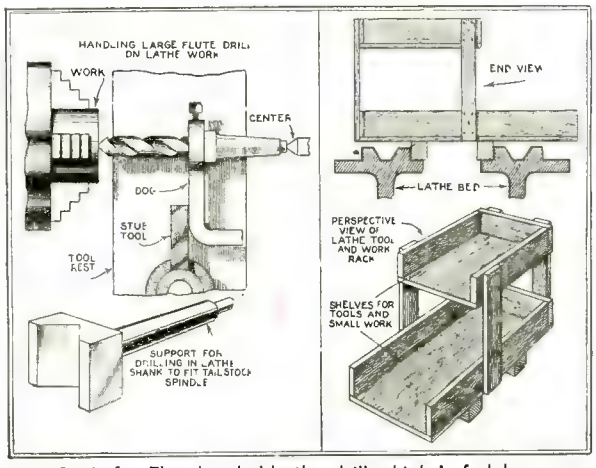

Fig. 2—Left—The dog holds the drill which is fed by means of a stock spindle. Below—Using a V support. Right—This sliding rack for tools will protect the lathe.

Large holes requiring big drills may be quickly bored by this means. It allows the use of drills with shanks not fitting the socket in the tail stock spindle—only a center in the drill shank is required.

Another means of lathe drilling is to use a *V* support, illustrated in the lower left view of Fig. 2. Circular work may be held firmly, and the drill secured by its shank or a chuck in the lathe head stock spindle. The spindle support will be found convenient in many drilling operations where speed is important.

Where work and tools are dropped on the lathe bed or carriage, the resulting nicks and dents in the machine frequently cause trouble. A nicked bed will throw the tail stock off center and result in error in the work.

A rack, as shown in the right side sketch of Fig. 2, will prove helpful. Made entirely of wood, this rack sits on the bed and can be slid to a convenient place either behind or in front of the tail stock. The rack can be made of short lengths of odd pieces of wood, and if you follow the sketch, the construction will be quite easy.

Its size depends to a large degree upon the work you do; however, the combined areas of the two shelves should be large enough to handle the usual jobs, done on the particular lathe, and hold the tools required for them.

Tools that wear out rapidly are much too expensive for the usual production jobs, and replacing them occasions delay. Grooving tools for production work, where quantities of duplicate material are made, sometimes proves impractical, as grinding changes the tool face width.

A desirable means of making a (*Continued on page 77*)

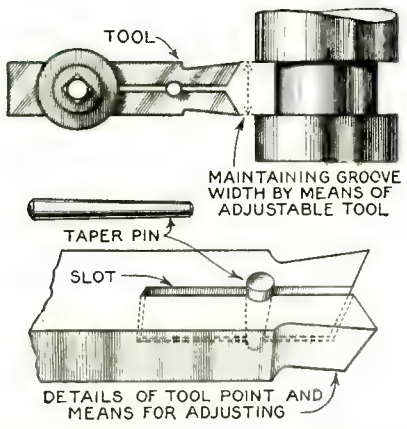

Fig. 3—With this tapered pin you can maintain a constant width at the cutting edge.

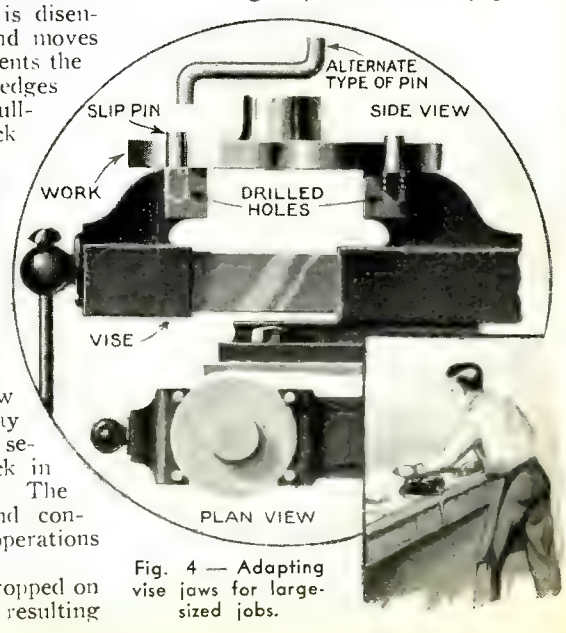

Fig. 4 — Adapting vise jaws for large-sized jobs.

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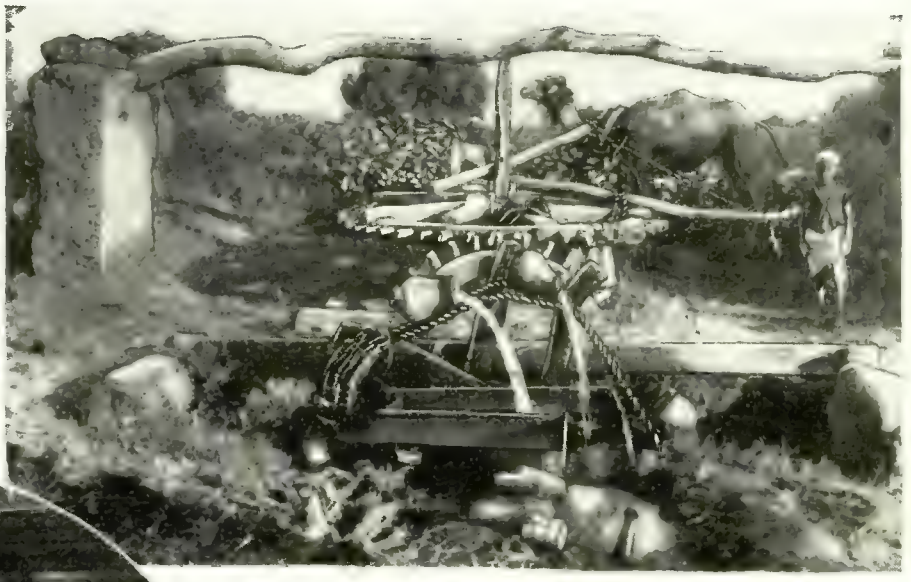
Would You Believe It?

Better Holes in Swiss Cheese

HAVE you ever stopped to consider just how the slice of Swiss cheese that you put on your buttered bread for breakfast got its holes? Or why holes differ in shape and size? And where the flavor of the cheese came from?

The holes are not machine made . . . they are the result of bacterial action upon the cheese. Thousands of little microscopic organisms feed upon the curds, thereby giving it its holes, taste, and pungent odor. An intensive study of these tiny bugs is being made by the U. S. Department of Agriculture. We see Miss Ailene Saunders preparing food for thousands of them.



Introducing the Egyptian Sakyeh

THEY still use the primitive sakyeh (irrigation wheel) in some parts of Egypt to water the fields. This one includes three wheels, as can be seen. The tree trunk supported by the two rock columns forms a bearing for the shaft of the horizontal wheel. To this horizontal wheel a camel is attached, and, as it goes round and round, the wheel revolves. Pins projecting from this wheel engage those of a wheel in a vertical position, causing it to revolve. This wheel in turn motivates the third wheel (in this case crude wooden spokes held by pieces of rope) to which water pitchers are fastened. The pitchers dip into the well beneath the wheel.

Kodak—Thumb-Nail Size

WE have all seen vest pocket size cameras and tiny kodaks. Here's the smallest camera in the world. It is no larger than your thumb nail, yet it is mechanically perfect. Three months were required by master craftsmen of the Eastman Kodak Company to construct this Tom Thumb camera. It is hand made throughout. Jewelers' instruments and a microscope were the tools used in fashioning it.

It was made for the Queen's Doll House in England.

You take pictures with this miniature camera just as you would with a full sized one. The entire device is less than an inch long.

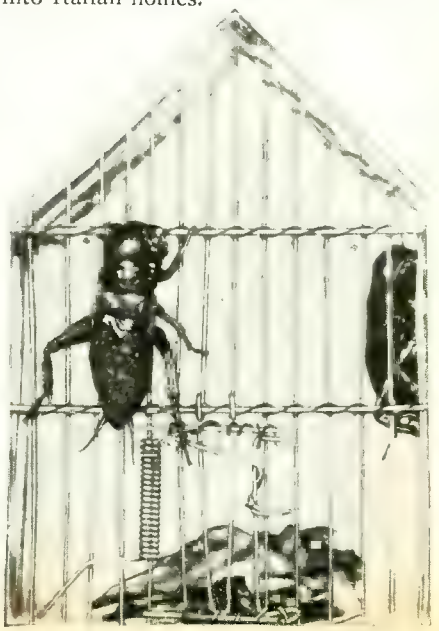
It's a Real Mouse Deer

THIS little animal is a real honest-to-goodness deer. Small size and odd appearance have given it the very apt name of mouse deer. Native to the jungles of Borneo and Sumatra, it is becoming more and more rare. This unusual specimen is housed in a glass cage at the New York Zoological Park, to make sure that it doesn't catch cold. The deer is 24 inches long, 8¾ inches high, and weighs 3¾ pounds.

Have you any WOULD YOU BELIEVE IT photographs? We will pay five dollars for every photograph accepted and published on this page. Send them in to the Editor of Would You Believe It.

Four-Winged Songsters

TO the Japanese, the chirp of a cricket is sweeter music than the song of the nightingale, thrush, or canary. In most Japanese homes you will find caged crickets. Italy is following suit, for vendors have lately been displaying caged crickets in the streets of Rome. Hundreds of these winged chirpers have found their way into Italian homes.



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New Tools You Can Easily Make

Every Machinist and Mechanic Finds He Must Execute Some Work for Which There Is No Suitable Machinery or Tool. Some Worthwhile New Products, Easily Constructed, Are Here Presented for You

By Joseph Pignone

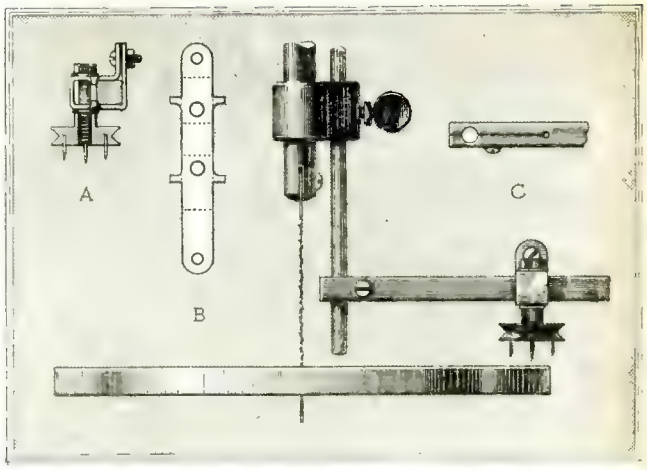

Fig. 4—For cutting circles on a jig saw, use this attachment.

NEITHER of the standard accessories to the lathe, the face plate or scroll chuck is very well adapted to conveniently work thin, flat metal. Very frequently inefficient wood makeshifts are used lest the face plate be damaged by the cutting tool. At any rate, the easily constructed chuck, as in Figs. 1 and 2. is expressly designed for this work.

First turn a tapered shank to fit the live spindle hole, leaving a shoulder against which the chuck plate screws. Thread its end for this purpose, and bore and tap a hole centrally through this shank. Then turn a plate of mild end steel and drill and slot its face as in Fig. 2.

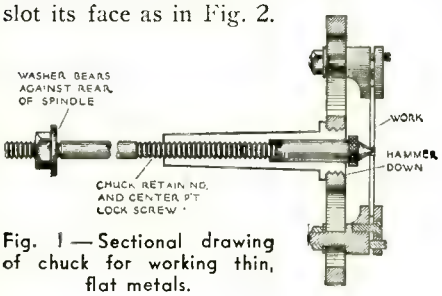

Fig. 1—Sectional drawing of chuck for working thin, flat metals.

Thread a center hole to force over the shank threads when the plate is heated. Hammer down the shank end projecting, and face off the whole plate and shank end.

The clamping jaw blocks may be made in any shape most convenient other than that illustrated. However, before screwing the jaws in place firmly clamp the four blocks in their slots and in turn, face them all off to the same height.

The knurled drill rod center illustrated is not absolutely essential, although it is quite valuable as a support and means of centering in some cases. Its 60-degree point is turned after the shank is screwed firmly into the chuck.

In order to prevent the chuck from loosening out of the spindle hole while working, a clamping rod is made to pass completely through the spindle hole. If the centering point is used, the rod also serves to maintain it in position by locking against its threaded end.

Clamping fixtures of the type shown in Fig. 3, have gained widespread acceptance in the manufacturing industries, and a simplified variation should prove of great utility to the home mechanic.

These vise fixtures are to be used to clamp odd shaped pieces for milling, drilling, and shaping operations. Frequently it is almost impossible to hold such work in ordinary plain vises.

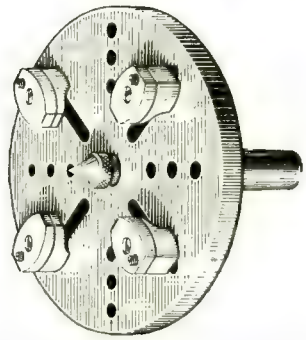

Fig. 2—The chuck assembled, ready for use on the lathe.

Of course, for milling or planing, where the thrust is sideways, an auxiliary piece behind the work must be provided to hold it laterally. However, since drill press work is most likely to interest the reader, the arrangement shown should suffice.

The fixture as illustrated has been reduced to the simplest practical form, and it may be elaborated to suit individual requirements. For instance, more pins may be included, or perhaps two rows of them may be better suited.

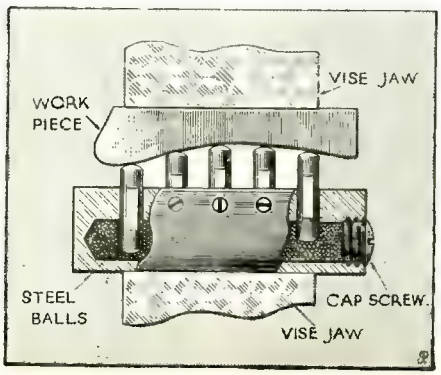

Fig. 3—With this device, odd-shaped pieces can be firmly held in the vise.

The body of the device is made of a solid rectangular cross sectioned length of soft steel. A large hole is drilled lengthwise into it, and tapped to receive a cap screw. Holes are drilled along a narrow face of the bar to accurately receive the locating or clamping pins. As illustrated, these pins are so filed, that set screws permit them to slide, but not to rotate or fall out. The large center hole is filled with lead shot, or better, with fine steel balls and grease.

When pressure is first applied to the fixture and the work, the pins adjust themselves to the contour of the work. Then as pressure is increased, the pins will resist further change of position until a rigid clamping action takes place.

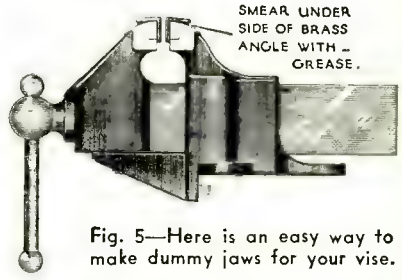

Fig. 5—Here is an easy way to make dummy jaws for your vise.

An efficient and extremely useful attachment is that illustrated in Fig. 4. While it is shown clamped to a vertical type of hold down rod, the radius arm of the device may be attached to any type by suitable screws. As it is often essential to have a disc unmarred by the usual center hole necessary in circular sawing, this accessory proves indispensable. Simply measure the radius in from one side of the stock to be sawed and pencil mark the center then press the spur wheel point into the mark. clamp down the radius block and radius arm, and saw out a disc.

Procure a length of soft steel 5"×½"×½" for the radius arm and drill and slot one end as at "C." Brass or steel 3¾"×1"×1/16" will do as the radius block. It is properly filed, drilled and bent to form as at "B" and "A." An ordinary bolt passed through this block with two brass washers serves as a spindle for the spur wheel. One spur point is forced into a hole in the bolt

(*Continued on page 76*)

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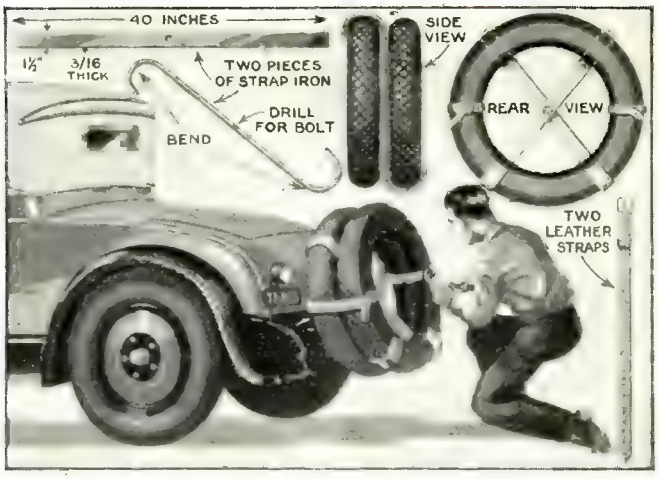
Dressing Up the Car for Spring

Liberal Use of Wrench and Pliers at the Beginning of the Season Will Reduce Garage Bills Later On . . . A Two Tire Carrier and Detachable Luggage Rack Will Help Toward Enjoyment of Week-End Trips



This simple tire carrier, made of strap iron and leather, will hold two spare tires.

By Arthur George
Consulting Engineer

WHEN tires have seen twenty thousand miles or more of service, a blow-out is always imminent, and an additional puncture is quite possible. The driver who has provided himself with two spare tires need feel no undue anxiety about what he will do if a couple of tires become useless. Here is the way a two place rack can be made.

Two pieces of strap iron, and two leather straps, which are comparatively cheap, provide the necessary materials. The iron rods should be about 40 inches long and bent to the shape of an S. Each is drilled to the center and secured with a small bolt. The two leather straps to keep the tires together complete the job, as can be seen from the sketch.

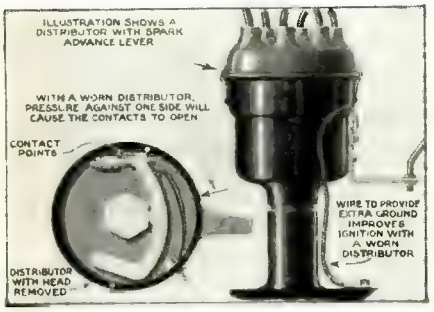
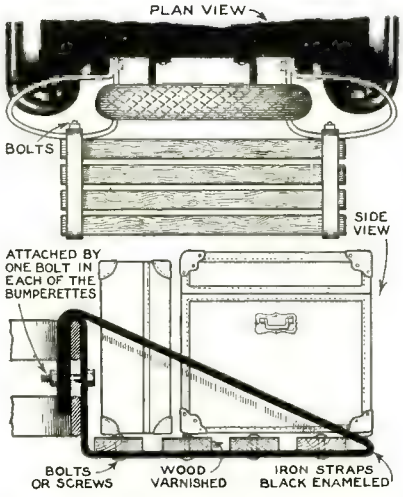


ILLUSTRATION SHOWS A DISTRIBUTOR WITH SPARK ADVANCE LEVER
WITH A WORN DISTRIBUTOR, PRESSURE AGAINST ONE SIDE WILL CAUSE THE CONTACTS TO OPEN
CONTACT POINTS
WIRE TO PROVIDE EXTRA GROUND IMPROVES IGNITION WITH A WORN DISTRIBUTOR
DISTRIBUTOR WITH HEAD REMOVED

Misfiring can usually be traced to trouble in the distributor. Adjusting the operation of the breaker points or overcoming faulty ground contact will usually prove sufficient to remedy this condition.

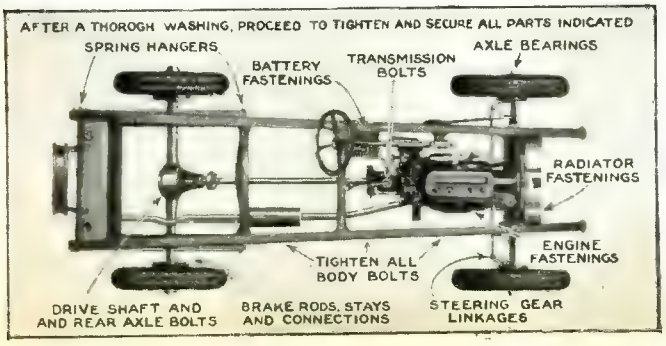
What a discomfort it is to pile bag and baggage inside the car, on everyone's lap, and all along the outside! Yet for long trips and early Spring weekends, it is quite necessary to carry a good deal of luggage.

To solve the problem of where bundles should be placed, one motorist constructed a detachable rear trunk. Two brackets, made from light iron straps, are provided with wooden crossbars, as can be seen from the sketch. These brackets are identical; a bolt attaches each one to the bumperette to the side of each rear tire. Wooden slats can be bolted to the brackets or, if you desire, screws can be used. Cases and bags are secured with ordinary trunk straps.



You can solve the problem of where to put baggage by constructing a detachable rear trunk rack.

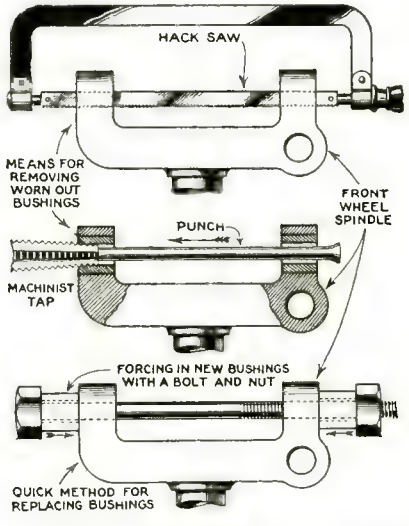
The rack is fastened in place or removed by means of the two bolts only. You will find that when using the car for daily business trips, it is better to leave the rack behind in the garage. Otherwise it might prove quite difficult to park your car in a small parking space.



A chart of the major points to be adjusted in your early Spring inspection.

When explosions in the muffler indicate that the owner is providing an unintentional July 4th celebration, the ignition is usually responsible. Misfiring with resulting muffler shots is most frequently caused by some difficulty in the distributor. The intermittent contacts of the breaker points may be at fault; if the cam shaft is worn in the distributor body, the contact is imperfect. When investigating, set the points to gauge, and push the distributor body sidewise. If there has been wear, the points will separate. They should be so adjusted that they will not open even if the body is displaced.

A second source of trouble may be imperfect ground contact. If a wire is fastened to the body, and to the casting below the shaft, as illustrated, faulty ground contact in the bearing or in the meshing gear at the end of the shaft will be overcome.


HACK SAW
MEANS FOR REMOVING WORN OUT BUSHINGS
FRONT WHEEL SPINDLE
PUNCH
MACHINIST TAP
FORCING IN NEW BUSHINGS WITH A BOLT AND NUT
QUICK METHOD FOR REPLACING BUSHINGS

Installing new bushings for the front wheel steering spindles.

The first warm Spring day is a good time to inspect your car to eliminate the looseness occasioned by hard winter driving. First remove the mud the chassis has gathered. A thorough wash-

(*Continued on page* 82)

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The S. and I. Globe Trotter

The Following Article Gives Full Constructional Details of a Modern 4-Tube, A.C. Operated Short-Wave Broadcast Receiver for Loud Speaker Operation. The Range of This Phenomenal Set Is World-Wide

Simplicity, both in appearance and of control, is the keynote of the S. and I. Globe Trotter, as the above illustration of the complete receiver clearly shows.

By George E. Fleming

TO be actually modern, a radio receiver must be operated from the alternating current lines, as batteries are a constant source of annoyance. This is also true of a receiver designed especially for short-wave broadcast reception, as it will always be used with a loud speaker and never with phones. This is not true of a "Ham" receiver, naturally, but it was not our intention to design a receiver for that service.

Another thing to be borne in mind is that the modern short-wave receiver has no more excuse for radiating squeals and howls than has a broadcast receiver, for unless this factor is taken into consideration we will shortly have the same situation on the short waves that we had in the broadcast band a few years ago, when it was impossible to listen to a program without having it spoiled with radiations from "bloopers."

So the problem boiled itself down to designing an a. c. operated short wave receiver with at least one stage of radio frequency amplification ahead of the regenerative detector. As we must use plug-in coils to cover the wave bands, it was necessary to ascertain the minimum number of tuned circuits necessary to obtain adequate selectivity. Tests proved that from the standpoint of selectivity one tuned circuit was enough, and by using it in the plate circuit of the screen grid radio frequency tube appreciable amplification was obtained from that tube, so the design given herewith was definitely decided upon.

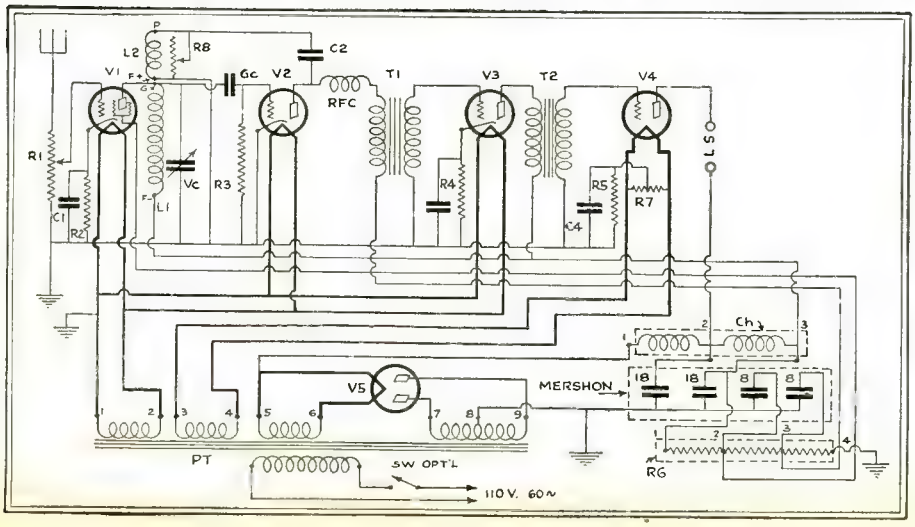
The selection of the parts to be used was not such a problem as might be at first thought. Manufacturers are now making parts small, and yet with generous safety factors, so that they are convenient as well as safe to use. The electrolytic condenser is indicative of this trend, packing a great deal of capacity into a comparatively small space. The transformers and chokes were chosen with the same end in view, and the ones selected are ideally suited to the purpose. The remainder of the parts were picked for their electrical as well as physical advantages. The overall size of the container was determined by laying out all the parts into the least space possible for convenient wiring and then measuring up the space. It was found that the case need only measure 10" x 14" x 8", these dimensions being depth, length and height, respectively. This allowed plenty of room for the parts and resulted in a neat, compact unit. The total cost of parts, as listed on this page, is $40.10.

LIST OF PARTS.

1 Blan Special Aluminum Cabinet.
1 Pilot A & B Power Transformer, Cat. No. 411.
1 Pilot Double Choke, Cat. No. 431.
2 Pilot Audio Transformers, metal case type.
1 Mershon Electrolytic condenser, 18-18-8-8 mfd.
2 Flechtheim Bypass condensers, 1 mfd.
6 Eby Sockets, 3 four-prong, 3 five-prong.
1 National .0005 variable condenser.
1 Kursh Kash 3-inch Port dial.
1 10,000 ohm Yaxley potentiometer.
1 50,000 ohm Carter variable resistance.
1 Electrad voltage divider resistance, 13,000 ohms.
1 .1 mfd. Sprague fixed condenser.
1 .0001 Aerovox mica condenser.
1 .002 Micamold condenser.
1 5 megohm Lynch resistor.
1 Alcoa shield, as designed by Laurence M. Cockaday for the LC-27 receiver.
1 Eby Antenna and Ground terminal strip.
1 Eby speaker duo-jack.
1 Roll special hook-up wire. See text.
2 Brackets to mount coil socket.
1 National Grid Grip Clip.
1 Set "Octo" Coils.
Hardware.

Analyzing the circuit completely, we find that the antenna volume control consists of a 10,000 ohm potentiometer, the sliding arm of which goes to the grid of the type '24 radio frequency amplifying tube. This tube is self-biased by a 600 ohm resistance in the cathode-to-ground circuit. This bias resistance (R2) is bypassed with a .1 mfd. non-inductive condenser (c.), one of the small moulded, mica dielectric jobs. The plate of this tube, in turn, goes directly to the tuning coil, or rather to the four-prong socket which serves to hold the coil, as the coils must be of the plug-in variety. To be specific, this connection goes to the grid terminal of the socket. The other end of this winding, designated as L1 in the wiring diagram, goes to B plus, through the filament connection on the socket directly below the grid connection. The plate of the R. F. tube is also connected to one side of the grid condenser of the type '27 detector tube (V2). This condenser is also of the moulded, mica type, .0001 mfd. capacity and shown in the diagram as Gc.

The other connection of this condenser is connected directly to the grid of the detector tube, which is also connected to one side of the five megohm grid leak (R3). The other end of the grid leak is connected to ground at a convenient point. We thus see that the grid condenser serves two purposes, one as a blocking condenser to prevent the high voltage on the plate of the R. F. tube from being applied to the grid of the detector tube, as well as acting as a grid condenser to accomplish detection.



Complete schematic diagram of the circuit of the S. and I. Globe Trotter.

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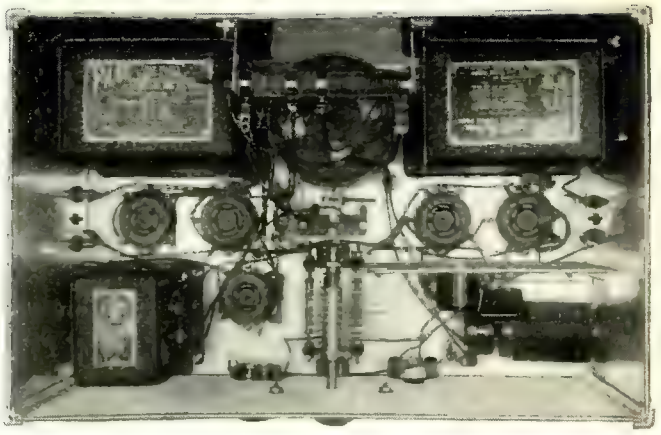
The tuning condenser (Vc) is shunted directly across the coil in the plate circuit of the R. F. tube, as is clearly shown in the diagram. In the list of parts it will be noticed that a National .0005 condenser is used. This was selected because it is a very rugged condenser and one that is easy to obtain when one is unable to get the special short-wave condenser. The capacity is reduced by removing all of the stator and rotor plates from their respective mountings and replacing them, using two spacing washers between plates instead of one. Of course, only one-half of the plates will be used, the others being discarded. A thorough examination of the condenser will make the method much clearer than would unlimited text.

Feed-back from the plate of the detector tube, to make this tube regenerative, is of the type known as "shunt feed." A radio frequency choke (RFC) is placed in series with the primary of the first audio frequency transformer (T1) and the plate of the tube. Connected to the plate is a small condenser (C2) of .002 mfd., whose other side goes to the tickler coil (L2), or rather to the plate connection of the coil socket. As the radio frequency choke has very high impedance to the passage of R. F. current, this current will take the easiest path to ground, which in this case is through the condenser C2 and the tickler coil. The "low potential" side of the tickler coil is connected to ground through the filament connection on the coil socket directly below the plate connection.

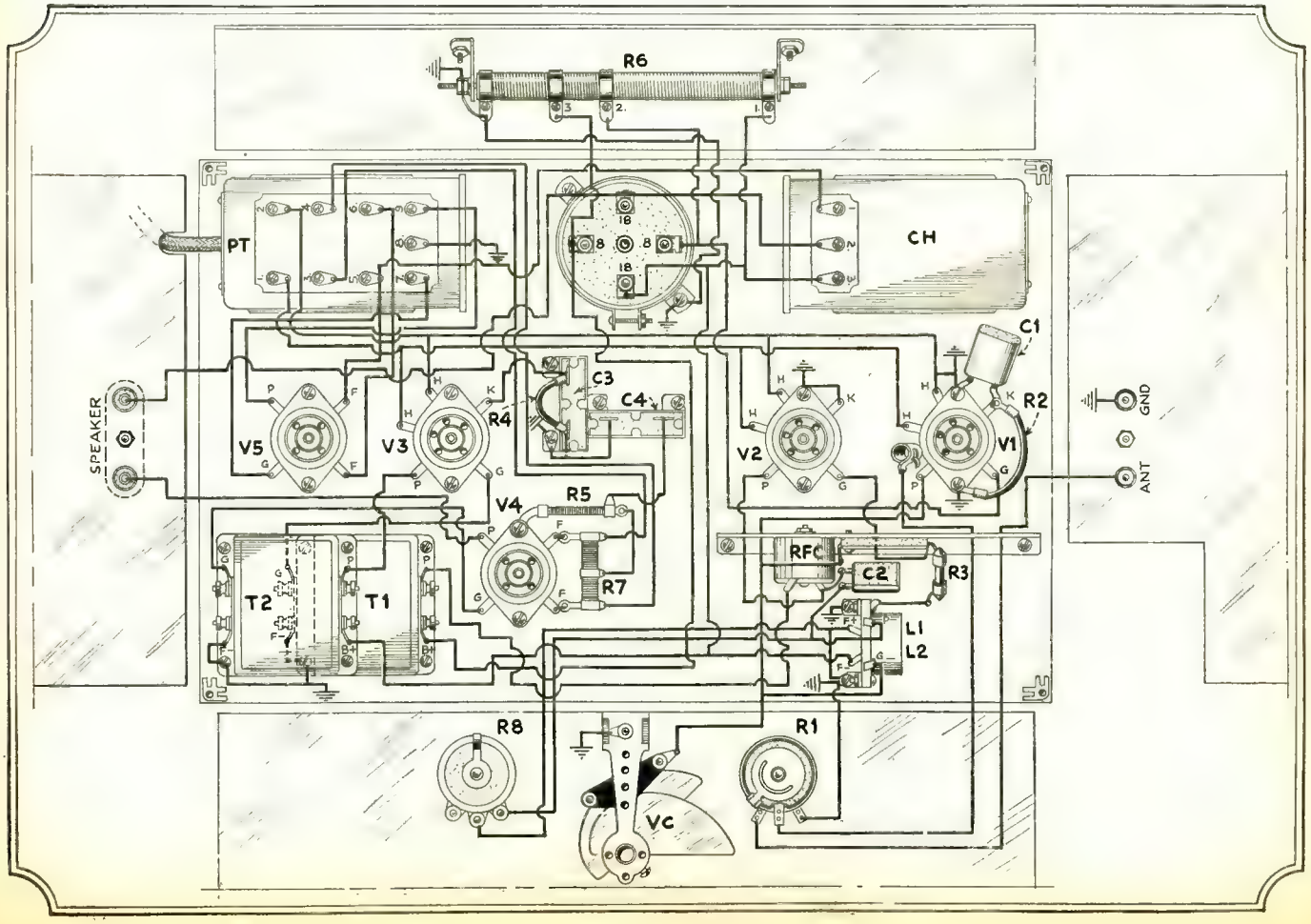


As this interior view (taken from above) shows, the parts are compactly yet symmetrically arranged. At lower right can be seen the interchangeable tuning coil, which is inserted and withdrawn through an opening in the right-hand side of the case, as shown in another photograph. In laying out parts, compare the above picture with the pictorial wiring diagram given below.

Regeneration is controlled by a variable resistance, R8, of 50,000 ohms, which is shunted across the tickler. This results in a very smooth regeneration control and permits us to use a fixed tickler. A fixed tickler coil on a short-wave set is almost a necessity, for if we used a variable coil, as we once did in broadcast receivers, the main tuning dial would, of necessity, have to be readjusted every time we changed the amount of feed-back, and with a sharply tuned receiver such as this one, it would result in a receiver next to impossible to tune.

The audio frequency amplifier is standard in every way, consisting of a '27 tube in the first stage (V3) and a '45 tube in the power output stage (V4), transformer coupled. Both of these tubes are self-biased, the '27 tube by a 1,500 ohm resistor, R4, which is by-passed with a 1 mfd. condenser, and the '45 tube by a 16,000 ohm resistance, R5, which is also by-passed by a 1 mfd. condenser, C4. In the case of the '27 tube, the bias resistor is connected between cathode and ground, while the '45 tube requires a center tapped resistor in the filament, which is shown in the diagram as R7. No output transformer is used in the plate circuit of the power output stage, as it is assumed that almost without exception it will be desired to use this receiver with a dynamic type of loud speaker. Should the reader desire to use a magnetic speaker, any of the more familiar choke and condenser or transformer outputs may be used. No provision for phones has

(*Continued on page* 90)



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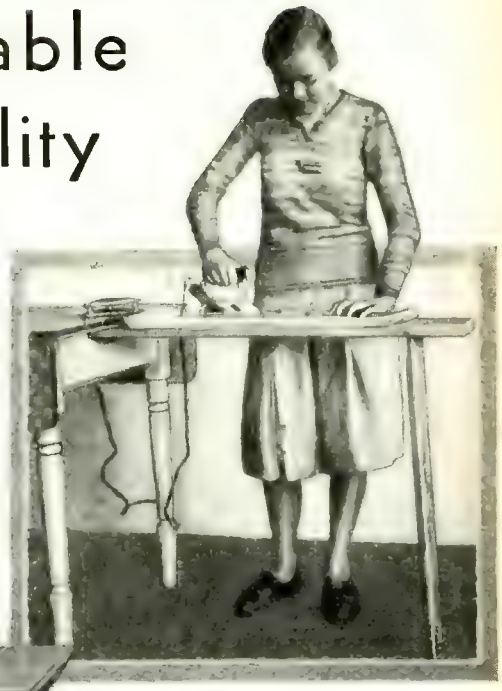
Converting a Kitchen Table Into a Space Saving Utility

Your Kitchen Table Can Contain a Cabinet for Storage Purposes, Breadboard, Silverware Tray, Disappearing Ironing Board, and Provide Additional Space for Preparing and Serving Meals

By H. L. Weatherby

Director of Manual Training, Montgomery County Schools, Montgomery, Alabama



The ironing board is concealed within the table top when not in use.

WHAT about rebuilding that old kitchen table this month? In the first place, isn't it too low? We will ask the women who would use it all of the time as a work table. The chances are that when they stop to consider they will decide that their backs might be less tired at the end of the day if the ordinary table were raised anywhere from two to four inches.

Then, too, think of all of that empty space under the top. What about a cabinet for this wasted area? It would really be a simple matter to make a convenient storage place of this. And I wonder if we can't add an ironing board and a bread board to this thing, that we expect to make a cross between a kitchen cabinet and table, and make something sure enough useful out of the old piece of junk? Such were the writer's thoughts as he surveyed the antique article of furniture that had gone by the name of kitchen table and that had found its way into the basement because of its decrepit appearance. It had only one thing to recommend it. Its legs and frame were good and substantial.

When approached on the subject the boss of the family decided that if anything could be done with the old table—"and she really needed a table"—that a few inches increase to the height really would help a whole lot. She suggested also that if a couple of leaves could be added the general usefulness of the table would be increased, and then we could also eat off it when occasion demanded.

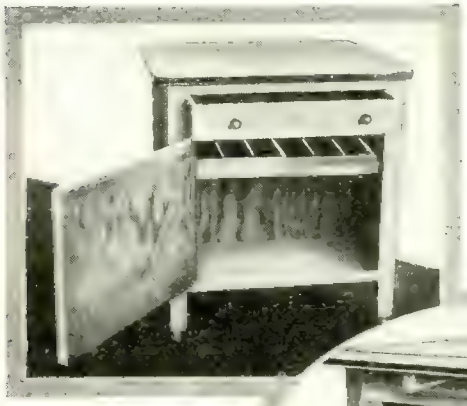
Just an ordinary kitchen table which can be converted into a general utilitarian combination.

With these suggestions and backed by our own ideas, we started to work. In the first place that warped top would have to come off. We pulled it off, sawed it up into strips and re-glued it and, by adding a small piece, made a very straight and flat top. Leaves were hinged to the sides and then we went to work on the folding ironing board. This was made so that it would slide in tracks attached to the underside of the top. Openings were cut in both ends of the table in order that the board might be full length, and a leg was hinged near the outer end to drop down when the board was being used and to fasten in place with a wooden button when the leg was folded up under the top. A stop consisting of a cleat had to be placed to prevent the board from sliding out, as it was used and to stop it when it was pushed back into place.

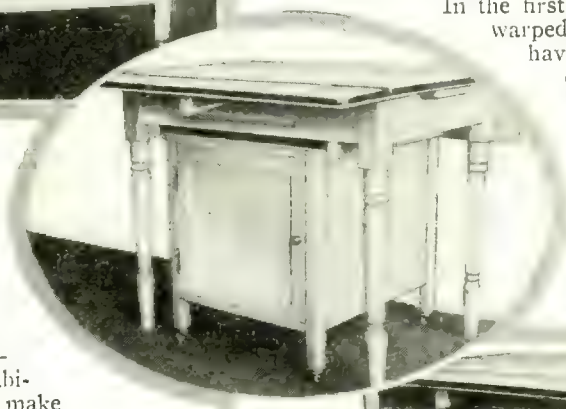
A bread-mixing board was made up with end cleats to prevent warping, to slide into an opening that we cut in the side rail of the table.

The cabinet to fit under the table was the next item of construction to undertake. We decided that if that could also be slipped in and out, extra table space would be available for parties and special occasions. The cabinet was built up in the manner of a table, of good, sturdy construction, with four legs and ⅜" ply-wood sides, middle upright partition, and shelves. This construction combined strength with light weight. Both sides were fronts in that they both opened with doors. One side had a drawer at the top, extending to the middle partition and divided into compartments for the kitchen silver. Good, strong slides were then fastened in place with long

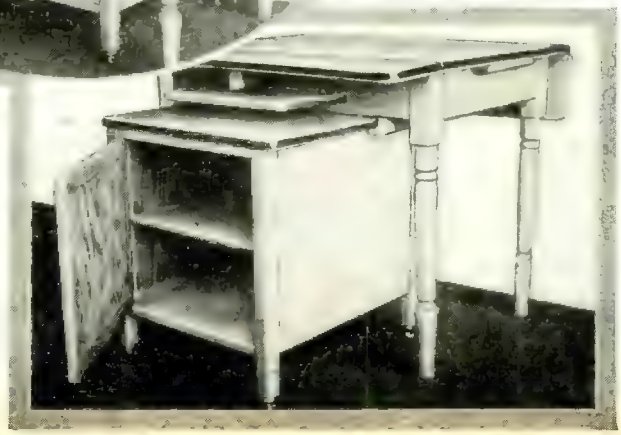
(*Continued on page 70*)



A very neat tray for silverware can be fitted into the cabinet.



The drop-leaf in place.



When the cabinet is pulled out from beneath the table, extra table space is available.

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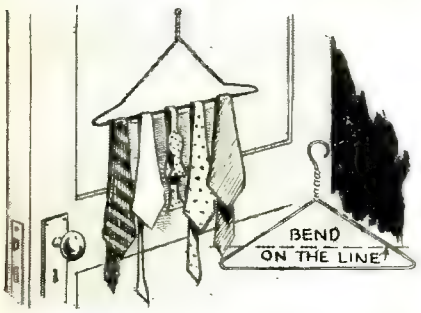
Wrinkles and Recipes

Improved Tie Hanger

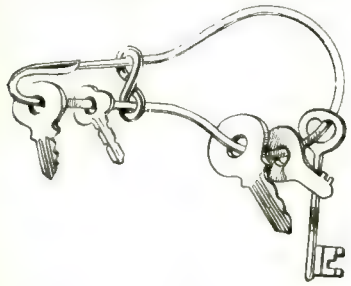
IT requires just a moment to make a hanger for your ties. Bend a wire coat-hanger in the manner indicated in



the drawing. Hang it against the wall of your closet or against the door. The weight of the ties tends to keep the hanger in place.—*Fritz Krag.*

Handy Key Ring

A VERY handy key ring can be made from a bathroom shower-curtain hook and a piece of wire, shaped like a figure eight (8), to be placed on the projecting part. One or two special or frequently used keys may be kept separate from the others by putting them on the small loop, as indicated. The figure 8 piece may be made by flattening a link of "single jack" chain.—*Mortimer H. O'Connor.*



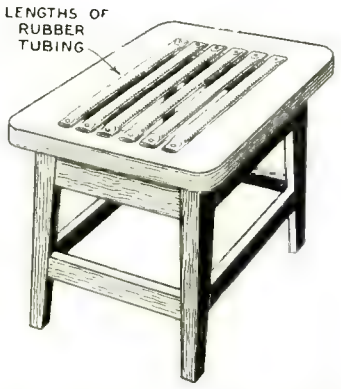
Weatherstrip for Garage Doors

THIS weatherstrip will prove quite effective in keeping out rain, snow and sleet from openings. Use a strip the length of the opening and about the size of the common lath. Tack upon this a piece of inner tube folded over. Then nail the strip to the bottom of the door so that the rubber will be compressed. This will make a tight joint. If the door is too close to the floor, it will require cutting off.—*Dr. John Hodgen Lucas.*

First Prize, $5.00

A Cushion Seat

IT becomes very tiresome when a person has to sit on a hard seat or chair for a number of hours at a time, especially the driver of a delivery wagon, if he must ride for hours in a jouncing vehicle. However, this inconvenience can be overcome in a very simple manner.



If the seat of the wagon is solid, a hole a trifle over a foot square should be cut into it and lengths of one-inch diameter rubber tubing fastened transversely over the hole. These lengths of rubber tubing should be laid as close together as possible and fastened by driving nails through the ends of them into the wood. The pieces of tubing should each be about a foot and a half long. This makes a very soft and comfortable seat for the car and one that absorbs most of the jar from riding. If rubber tubing is not available, flattened lengths of old inner tube can be used.

Cushion seats of this type can be made to take the place of the regular seats in old kitchen chairs or work chairs and will prove a great comfort to the housewife.—*Charles Felstead.*

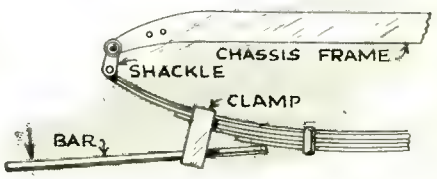
$5.00 is paid each month for the best Wrinkle or Recipe accepted and published in these columns. All others used are paid for at regular rates. Address: Editor, Wrinkles and Recipes.

For Packing China

WHEN packing china, glass, or canned fruits for moving, use excelsior well dampened. It will shape itself to the articles which are enclosed, forming a safe and solid framework. Wrap small pieces, such as the teapot and sugar bowl lid, in red crêpe paper, so that they will not be apt to be discarded with the wrappings when you unpack.—*Mrs. H. E. Christman.*

Replacing Shackles on Automobile Springs

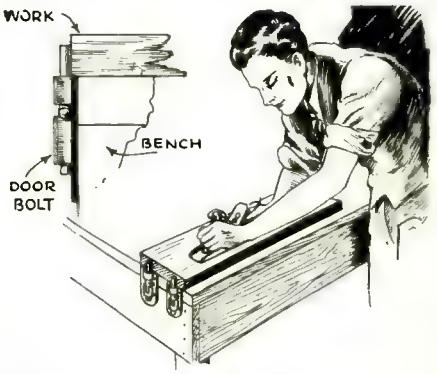
WHEN shackles break and are being replaced, one usually has a lot of trouble to assemble new ones



on a car. This can readily be overcome by jacking the body of the car up a little bit to relieve the strain from the spring. Then place a clamp or short chain around the spring and insert a bar. Press down, and the shackle can be easily replaced.—*Joseph Petrick.*

Bench Stop from Door Bolts

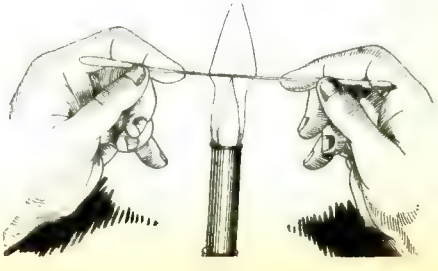
THE door bolts fastened to the end of the work bench, as shown here, can be instantly lowered out of the way when a planing stop would be a hindrance in certain types of work. Being screwed to the table top, they are not likely to be torn off when particularly hard wood is planed.—*R. Wailes.*



Burette and Pipette Tip Cleaner

A SIMPLE means of removing particles lodged in burette or pipette tips is this one:

A short section of small diameter glass rod is heated in the gas flame and quickly drawn out into a fine thread. On cooling the thread is broken up into short sections and preserved in a vial, together with the tapered ends of the rod. These pieces of glass thread may be drawn sufficiently fine to penetrate the smallest capillary openings and dislodge particles that have become wedged in the burette or pipette tip.



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Scientific Problems and Puzzles

Can a Magnet Have Two Similar Poles at Each End? Is Steel Stronger Than Silk? How Many Electrons Pass Through a Lamp Filament? Read the Detailed Questions and Answers in This Article

By Ernest K. Chapin

JERRY TIMBERLAKE, a Negro inventor, has been advertising in mid-Western towns a fuelless motor for filling stations, railway stations and the like. The plan is as follows: Every time a car stops at a pump for service, the platform on which the car stops is lowered two inches, thereby operating

Our illustration shows a bar magnet with two south poles. Do you think this is possible?

a system of levers and a pump which raises water to an elevated storage tank. The water from the tank then turns a water wheel which is connected to an electric generator. The electric energy thus obtained is sufficient, so the inventor claims, to light and heat the station and motivate the air compressor. When the car leaves the platform the latter is automatically brought back to level by powerful springs. It is then ready for the next car to do its bit toward upkeep of the station. In an interview with the inventor the writer was assured that a few platforms of this type situated on a busy street would furnish enough "juice" to light the streets. For the home owner, Mr. Timberlake suggests a hand-operated pump, which he estimated would need to be operated but a few minutes a day to supply both light and heat for the home.

Any proposition, like this, which offers to make the other fellow pay our bills looks very alluring, so we invite our readers to get out their pencils and figure a bit on its possibilities. To make the problem definite, let us take a station that burns forty 100-watt lamps (this is not at all unusual).

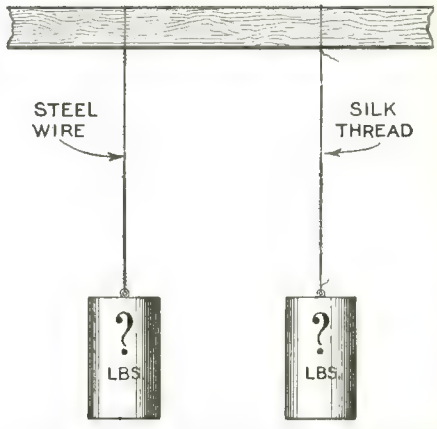
Now assume that the whole system is 100 per cent efficient and that the cars average 3,000 lbs. apiece. How often must a car stop at the station and depress the platform to furnish the equivalent power? Remember that the platform is pushed down only two inches each time a car stands on it.

An elevator cage is equipped with a differential hoist arranged so the occupant can raise and lower himself at will by pulling on the rope, A. The upper block consists of a wheel and axle fastened rigidly together and turning on the same bearings. The wheel is 10 inches in diameter and the axle 5. Rope B is wrapped several times around the axle and has its extremity fastened to the axle. Assuming that the cage and occupant together weigh 400 lbs., and that friction is negligible, how hard must he pull on rope A to raise the elevator?

Nature seems to have decreed that for every north pole there shall be a south pole. Most bar magnets certainly have opposite polarity at the ends. Did you ever see one that had the same polarity at the ends and hence would not act like a compass, even though fully magnetized? How could you make one such as is shown in our illustration?

Electrons are so unimaginably small and so intangible that we are sometimes rather fearful of any problem which deals with them numerically. Amperes, volts and watts, on the other hand, are such common terms that we are not afraid to trust the result of problems

The cage and man weigh 400 pounds. Friction is considered negligible. With what force must the occupant pull the rope A to lift himself?



A steel wire and silk thread of the same diameter; which will support the greatest load.

involving their use. For example, most folks will not question the statement that a 25-watt lamp will draw a fifth of an ampere on a 125-volt line. But if asked to compute the number of electrons passing each second through the filament of this lamp they will throw up their arms in despair. Such a problem, they think, can be solved only by one well versed in higher mathematics. It is really very simple, however, for experiments show conclusively that an electron passing each second through a filament is equivalent to a very definite fraction of an ampere. That is it takes 6.3 million million million electrons per second to equal one ampere of current. Now figure for yourself the number that pass through a 25-watt lamp.

Substances, like people, often get undeserved reputations. Rubber, for example, is nowhere near as elastic as glass or ivory. It is merely stretchable. Glass and ivory recover more readily after they have been distorted and hence are more elastic. The apparent elasticity of rubber balls is largely due to the air within them. Solid rubber balls do not bound as well as glass marbles or steel bearings. With this warning consider the relative tensile strength of steel and silk. If a steel wire could be drawn to the same diameter as a silk fiber, which do you think would stand the greater load, the silk or the steel?

Answers to the Problems

THE answer to the question whether silk is as strong or stronger than steel is "it all depends." Some silk

(*Continued on page* 81)

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Conducted by
Seymour A. Davidson

Stereoscopic Views Made Through Lined Screen

(2390) Mr. John M. Wilunas, Detroit, Michigan, writes:

Question 1. I thank you for the answers you sent me before. Will you be so kind as to explain through SCIENCE AND INVENTION the following?

I have seen in the store windows signs which show the pictures in relief, or third dimension. The glass where the picture is projected on, is finely grooved. What kind of pictures are used in there. Are they just plain flat pictures, or are they double, like stereoscopic views? Will you kindly explain?

Answer 1. The pictures which interest you are made by a camera which moves during the exposure in an arc of a circle about the object photographed. In the back of the camera is a lined screen which has very fine vertical transparent lines on an opaque ground.

The photographic plate is placed directly behind the screen. During the exposure, the plate is moved gradually in a horizontal direction back of the lined screen; the distance it travels is very short.

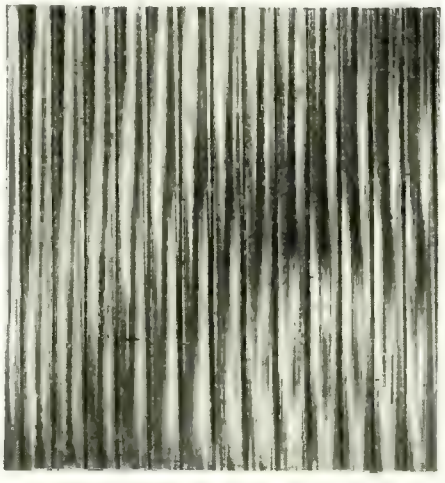
At any instant, when the camera is moving, it records a particular aspect of the object, the image of which reaches the photographic plate under the lines as they are at that instant. As the camera continues to move, it records other aspects of the object on slightly different parts of the plate.

From the negative so obtained, a positive is printed on a glass photographic plate. When this is viewed directly it is not stereoscopic and it appears blurred because it contains a number of different images. When, however, a lined screen like that used in the camera is placed in contact with the picture and properly oriented, and the picture is viewed with a light behind it, the screen picks out a single clear picture which shows the object from a single point of view.

If the lined screen is spaced slightly from the positive, the image which is seen depends upon the angle at which the picture is viewed. As one passes the picture, the changing aspect of the subject photographed causes the beholder to feel that he is looking at a real object; since he sees slightly different views with his two eyes, the result is a stereoscopic picture.

It is possible to present a limited amount of motion, for if the object photographed is moving, we see from a single point of view the aspect of the object at a particular instant, and as we walk past the picture it appears to move.

Right—The glass positive on which is impressed numerous views of the subject.



Left—This lined screen is placed in front of the glass positive. When properly oriented only one image can be seen at a time through the screen.

History of the Compass

(2391) Mr. Sydney T. Baker, Chicago, Illinois, writes:

Question 1. I am seeking information on the history and development of the mariner's compass. As instructor for Sea Scouts in Chicago, I would like to explain to them what manner of magnet and card was used by the early navigators after it was brought from China.

Having tried the Public Library without success, I am writing hoping you will be able to give me the desired information or the means of obtaining the same.

Answer 1. Appertaining to your inquiry on the subject of the Magnetic Compass, we would advise that its origin is involved in more or less obscurity. In a rough form, it is said to have been known to the Chinese two thousand years before the Christian era, though this is more than doubtful. It is a known fact that the policy of Chinese rulers and the habits of the people conspired to make the Chinese indifferent and unenterprising navigators, so that even if a knowledge of the directive property of a magnet were known to them, it is not likely that they were used to any great extent.

We find the earliest definite reference to a compass in a work entitled "De Utensilibus" that was written by Alexander Neckam in the Twelfth Century. He refers to the instrument as a needle on a pivot, which, when allowed to come to rest, shows the navigator the direction in which to steer. In another volume entitled "De Naturis Rerum," Neckam writes that a needle is supported on a point so that it is free to revolve and when this is touched with a magnet, it will turn around, and when its motion ceases the needle will point to the north. As early as the Thirteenth Century, the magnetic needle was known to navigators of all the European nations. In 1248, Hugo de Bercy speaks of an improved form of compass which consisted of a needle that was supported by two small floats in a glass cup. This needle did not swing and veer as did the other magnetic needles then in use that were supported from a pivot. The water in the cup evidently tended to suppress the motion.

The compass card was divided into thirty-two points and was already in use in 1391. It was first positioned under the needle. Mounting the needle directly on the compass card, or directly under the compass card, so that the card would be free to move with the needle, was a much later improvement. Unfortunately, we have no definite data as to when this style came into existence.

We would believe that the best possible way of explaining the action of a compass needle to Sea Scouts would

(*Continued on page 68*)

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CONDUCTED BY JOSEPH H. KRAUS

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Should advice be desired by mail, a nominal charge of $1.00 is made for each question. Sketches and descriptions must be clear and explicit. Only one side of sheet should be written on.

NOTE:—Before mailing your letter to this department, see to it that your name and address are upon the letter and envelope as well. Many letters are returned to us because either the name of the inquirer or his address is incorrectly given.

Sink Garbage Container

(1258) Mrs. V. Graziani, Fort Bragg, Calif. submits several ideas, the most important of which relates to a garbage can with a sieve-like inside construction. This can is intended for sink use.

A. Many attempts have been made to commercialize sink garbage containers. For some reason they have not met with the approval which they merit. Her construction is not by any means as impressive as shown in some of those now appearing on the market. In view of this, we doubt if a patent would be of value.

Three Decker Sand Toy

(1259) Mr. L. E. Baublitz, Washington, D. C. submits a patent relating to a sand toy comprising three revolving wheels and three sand chutes arranged under each other. He asks our opinion of its merit.

A. We do not see that there is anything wrong with your invention. Probably you have not gone about trying to exploit it in the right manner. If you cannot find a manufacturer who may be interested in constructing this product and putting it on the market, perhaps you could arrange to do so yourself. There is only one objection which we have to this sand toy, which objection is that the paddle wheels merely rotate. There is no other action to continue to interest the youngster. The construction, therefore, is no different from stacking one of the present model sand toys on top of another. There is no reason why something could not be done to improve the color effect which could be got with such a sand toy.

We would advise that you communicate with some of the organizations which handle the sale of patents on the royalty basis, and that you also communicate with various manufacturers of stamped metal toys, with a view toward placing this product on the market.

"Roll Your Own" Cigarettes

(1260) Mr. Albert Sollosy, Plunkett, Sask., Canada, has developed a system of providing an ordinary tobacco tin with an attachment so as to make it easy to "roll your own" cigarettes. He requests our opinion.

A. We doubt very much if the cigarette roller which you have designed will operate so as to give thorough satisfaction. Then the market for "roll your own" cigarettes is quite limited today. Cigarettes can be obtained nearly as cheaply in regular packages of 10, 15 or 20; they are packed better than any small hand machine could pack them; they are uniform in quality and in tightness of the packing; and they possess advantages which the "roll your own" type could never give.

From the standpoint of costs your suggestion is not practical, unless the item would be made in the form of an attachment that could be easily fitted to any tobacco tin and when once purchased, would not have to be followed by a second one. We believe that if you did succeed in patenting this project, you would be just adding another patent to the vast number that have already been granted on cigarette rolling machines.

What Is the Invention?

(1261) Mr. Alexander Kowalewski, Erie, Pa., states that he has designed an invention for airships. He wants to know what he can do with it and how he can have it financed.

A. It is quite impossible for us to tell you what you can do with your invention when we do not know what it is. Your communication has given us no details of the device.

The Goodyear Zeppelin Corporation, Akron, Ohio, manufacture airships.

Preventing Corrosion in Storage Batteries

(1262) Mr. H. N. Huntington, Florence, Oregon, asks whether we advise him to secure a patent on a substance to prevent corrosion of terminals and cables of storage batteries.

A. It depends entirely on the substance. You may or may not secure a patent on the same. There is no doubt that if the product does what you claim for it and if it is patentable, a successful market could be secured.

Multiple Type Rubber Band Airplane Motor

(1263) Mr. Kenneth Arnold, Purdin, Mo., submits a multiple type rubber band motor for model airplane use and requests our opinion.

A. We would suggest that you try this system out practically and see that it actually does what you claim for it. We are of the opinion that if properly constructed and properly perfected, an item of this character might meet with a favorable market, and prove a financial success. It depends on how the suggestion is to be exploited after a patent has been applied for and granted.

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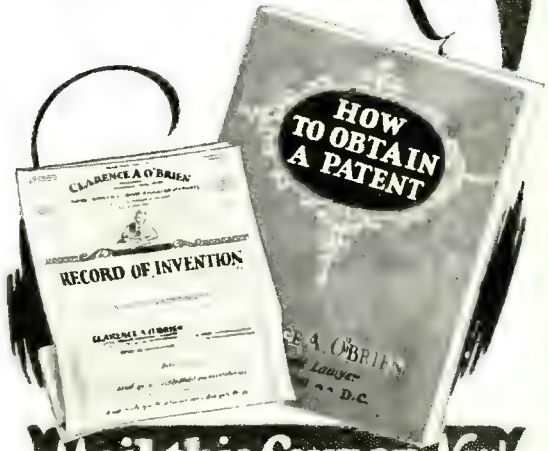

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Among the Inventors

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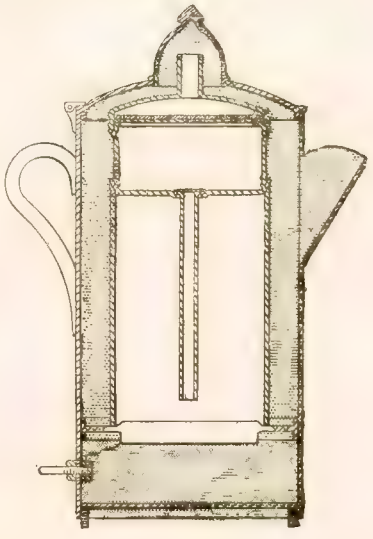
Coffee and Water Contact Once in This Pot

No. 1,774,927, Issued to H. L. Lambert

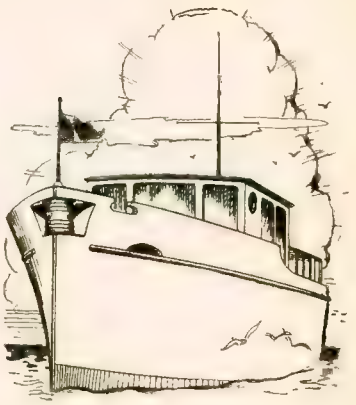
THIS invention relates to a coffee urn suitable for household use, construction of which insures the complete separation of the grounds from the finished beverage. The coffee urn carries a concentric can within itself, with a space left between the walls of the urn proper and the inner compartment, which contains the ground coffee in its upper portion, supported by a diaphragm, through whose center a vertical tube passes. The lower end of the tube reaches nearly to the bottom of the container. An electric heating unit in the bottom of the same boils the water. Steam forces the boiling water upward through the tube. The water permeates the grounds and absorbs the desired constituents and passes out over the top through a filter above the diaphragm and into the space provided between the walls of the containers.

In this way as the water passes through the grounds only once, a maximum of caffein and a minimum of tannin enters into the solution; obviously no sediment or grounds will be found in the finished product.



This Ship's Light Does Not Trouble Helmsman

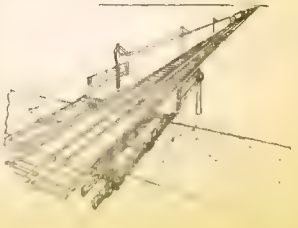
TOO often the pilot of a powerboat may be troubled by the glare of his bow-light which is usually carried on a staff. Patent No. 1,776,004, issued to A. Luders, attempts to do away with this annoyance. Mr. Luders places his lantern in a pocket which has been cut high up in the bow of the ship. The rear of this cavity flares at an angle of



twenty-two and a half degrees on both sides so that the light can be seen through an arc of two hundred and twenty-five degrees.

Railroad Crossing Gate

DESPITE the various precautional educational programs conducted by railroads and transportation authorities, there have been an appalling number of deaths incident to grade crossing accidents. All these fatalities can be classed as avoidable and inexcusable. Because of this serious loss of life various means have been improvised to prevent persons or vehicles from entering upon or crossing the railroad right-of-way while a train is approaching. Mr. M. E. McKee adds to the list of those who provide barriers for this purpose. As we note through patent No. 1,785,093, he would have a fence-like arrangement automatically raise itself from the ground as the train approaches. However, he has made no provision for the very unfortunate situation which would ensue should a vehicle have its front wheels past the barrier and its back wheels in front of the barrier just at that point of time when it begins to raise itself from the ground. Somehow or other, the thought of an automobile hung by the middle on a stout hickory fence waiting patiently for a locomotive to come its way and endswipe it, doesn't appeal to us. How the device operates when snow and sleet freeze the gate to the ground is also not made clear.



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Entertaining with Chemistry

(*Continued from page 49*)

water, the heat absorbed as the ammonia is expelled from the solution will reduce the temperature sufficiently to freeze mercury. The experimenter can readily show the production of this cold by blowing a stream of air through a solution of ammonium hydroxide in a beaker standing on a few drops of water on a wooden block. In a short time the beaker will be frozen to the block.

An interesting experiment is one showing the action of a protective colloid. When dilute solutions of mercuric chloride and potassium iodide are mixed an unstable yellow precipitate of mercuric iodide is formed. The precipitate rapidly turns to orange and then to red. If the experiment be repeated with a small quantity of gelatine in the potassium iodide solution the resulting mixture of the two solutions first turns light yellow and then becomes slightly turbid with a beautiful deep yellow color which persists for about half an hour before finally giving way to the deep red color.

Antimony trisulphide is an example of a chemical compound that exists in more than one modification. As commonly seen in the chemical laboratory it is a reddish-brown solid while in nature it is the mineral stibnite and is found in beautiful needle-shaped crystals with a dark gray metallic luster. In the presence of dilute hydrochloric acid the red modification is rapidly converted into the black variety. The speed of the change depends to a large extent on the temperature of the mixture.

Color Change in Amorphous Form

Add some of the red antimony trisulphide to a dilute solution of hydrochloric acid and allow to stand for several days. At the end of that time the change will have taken place. By heating the mixture to boiling the change occurs in a very short time.

The diffusion of two gases takes place very rapidly as can be demonstrated by bringing bottles of hydrogen chloride gas and ammonia gas mouth to mouth. Immediately copious white clouds of ammonium chloride are produced. Solids placed in contact with one another also diffuse, though the process takes place much more slowly. The experimenter may most readily prove this fact by making three small discs of gelatine. One is left clear and transparent, while the other two are colored by any aniline dyes that can be obtained. When these discs of gelatine are hard they should be stacked with the clear one between the colored discs. Place in a cool, undisturbed spot and note the progression of the colors into the clear gelatine over a period of several days. See Fig. 1.

Write a simple word or draw a simple design on a small glass plate with a moistened alum crystal. Invisible, minute crystals will remain on the plate and if the latter be placed in a supersaturated solution of alum crystallization will start at these minute crystals and the design or word will immediately become visible.

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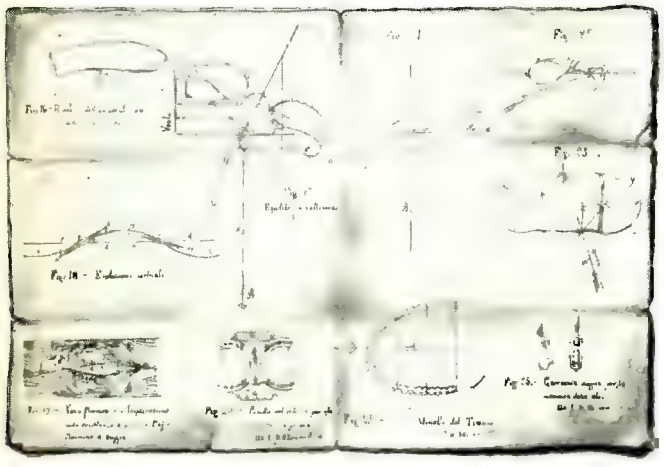
An Aviation Pioneer Historians Never Knew

(*Continued from page* 19)

i.e., two turbines on one shaft (one shaft within the other), one propeller each, and as at that time gasoline was unknown, I planned to run it with alcohol or compressed hydrogen gas as fuel. The drawings also call for a water cooling jacket, water tank and radiator, pumping and lubricating system, etc. The machine was to reciprocate so that when one motor became too hot, the other would start automatically.

"Then I laid out my complete plans for a regular dirigible which I called the 'Ital-ereo,' driven by such a motor. There were suitable propellers for ascent and descent in order to eliminate ballast, horizontal propellers for travel,



These drawings, taken from Mr. Raschella's original notes, reveal his grasp of aerodynamic problems as far back as 1895.

and an extra empty bag to receive the surplus volume of expanded gas, so as to avoid explosion, or the necessity for valving gas.

"At this time my conviction was so strong that such a dirigible had possibilities that I started to foresee the use of it in war. I then drew an aerial bomb which I called an 'Aerolite,' to be dropped, attached to a parachute and provided with a spike which on reaching the ground would embed itself at about the height of a man's breast, where it would become a small fortress, exploding with the impact and discharging 150 bullets at once in a circular direction and immediately after, by means of a separate charge, the whole thing would burst into splinters.

"Up to this date I had kept everything secret. No one knew anything of all my experiments, with the exception of some close friends, relatives and my mother, a wonderful woman, who helped me right along, especially with sewing. In those days people would ridicule me for trying these things, and look at me as though I were crazy.

"About December, 1894, I felt that I had accumulated enough material to make myself known, so I gathered all my small models, drawings and specifications and submitted my intentions to my teacher, Professor Cesare Mariani, who at this time was also President of the Institute of Fine Arts in Rome, in addition to being Professor there.

"He had a large number of pupils for drawing and painting lessons in the Nobility and Royalty of Rome, and through him I was introduced to His Excellency General Mocenni, then Minister of War, to whom I presented all the above-described plans and specifications.

"I had interviews, debates, practical demonstrations at the Government aerodrome, promises, adulation; but on February 26th, 1895, all my plans were returned to me as impracticable because of the foot power, and with verbal recommendations to build such a combined heavier and lighter than air dirigible, but driven by a turbine motor as suggested by me, at my own expense, and if it was successful the government would buy it from me.

"Up to this time my experiments had cost me about $4,500, a lot of money in those days. When, without funds, I appealed to the government, to the Prince of Naples (now King Victor Emmanuel of Italy), not a bit of help was forthcoming, in spite of all the records, demonstrations and so forth. It was time for me to give up.

"In 1899 I came to America, relying on my artistic ability, and became an American citizen. And now, as I feel myself getting old, I think it is my duty before I die to let the world know of my experiences, obtained in times when the gasoline, motors and air craft, of which I then had the vision, were not in existence.

"The points in which I still see possibilities and emphasize are combination heavier and lighter than air dirigibles, capable of alighting on land or water, equipped with a duplex air cooled turbine motor, or any good motor of modern design. Such a machine would be most practical for endurance and commerce, not for speed. It would also be practical for use in small sizes with small motors and a few gallons of gasoline for short trips for sport. One person alone, for instance, would be able to ascend and descend almost vertically from a comparatively small space, since the weight of the craft would be balanced by the lifting power of the supporting gas. Such a combined arrangement would soon become a practical sky flivver."

We have seen all the documents to which Mr. Raschella refers above, and they not only corroborate his claims fully, but they also reveal that he had at that time developed an extensive knowledge of aerodynamics which was not duplicated by others until some years later. For example, he built models of gliders and airships, suspended them by means of threads in a quiet room, and produced air currents in different directions by means of fans, in order to study the effect of different constructions on the reactions of his models to various currents of air. In this way he forestalled the modern wind tunnel used by all aircraft designers. He transferred the results of his observations to paper in the form of long theoretical notes, and also in the form of drawings, one such being reproduced here.

As regards evidence, the following is a translation of an affidavit which is also reproduced here in facsimile:

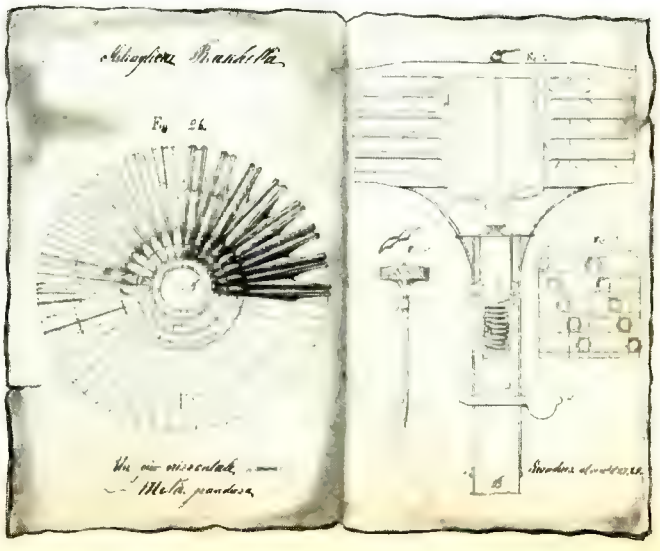
Caulonia, Italy, October 0, 1889.

Public Affidavit.

"We, the undersigned, wish to state that our mutual friend Vincent Raschella has been experimenting for the past three years on the art of flying.

"That we have assisted him in almost all his operations, and we have often helped him to construct such frames of bamboo, or cane and canvas.

"That in the past few months he finished a balloon on two wings equipped with two propellers, which he propels with his feet and thereby he succeeded several times in flying for some distance. He called this balloon 'The Falcon.'



Original drawings of Mr. Raschella's "Aerolite," or aerial bomb, described on this page.

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"We make this statement because Caulonia is a small town where there are no newspapers and we believe that this is the only means of confirming the above statements."

Signed Baron Nicola Asciutti
Luigi Giuseppe Neschis
Giuseppe Fonte
Luigi Franco

The following translation of a clipping from a newspaper, *L'Italia Militare e Marine* (the official military paper of Rome), dated January 22, 1895, is not only of value to Mr. Raschella's claims, but also provides an interesting commentary on the official mentality of those days:

"We are informed that at the Ministry of War there has been presented by Mr. Vincent Raschella, a project for an aerial dirigible which does not seem to be one of the usual utopias of seditious inventors. If so, the arduous problem of navigating the air would finally be solved. We are also assured that the invention of Mr. Raschella made a convincing impression on the committee delegated to examine the project, and in their estimation probably in about seven or eight months, or as soon as the necessary experiments are completed, he will be able to accomplish the first aerial voyage, using the motor invented by the young Calabrian inventor, well known for his studies in our government aerodrome."

A search through early aeronautical history provides ample evidence, in the form of illustrations of many weird and wonderful-looking craft, that man has tried for centuries to conquer the air by means of some form of navigable craft. But to find definite evidence that anyone had successfully solved the problem prior to 1889 proved difficult until, through the courtesy of the publishers, G. P. Putnam's Sons, we were enabled to delve into "The World in the Air," by Francis T. Miller (2 Vols.) which has just made its appearance. We then found an illustration of a balloon-airplane combination built and flown at five miles an hour by Frederick Marriott in 1869, in California. Marriott used a steam engine for his motive power. Later, in 1875, Paul Haenlein flew in Germany the first dirigible balloon, filled with coal gas and powered with a gas engine which was supplied with fuel from the supporting gas within the envelope.

While today Mr. Raschella quietly pursues his profession as a portrait painter and fresco artist, and has had no connection with aviation since he came to this country, it would appear that, although antedated by Marriott and Haenlein, he was not only one of the earliest pioneers of dirigible airships, but that he also had some sound conceptions of modern aeronautics. His glider experiments, at least, antedate those of Lilienthal (1891), and it is remarkable that even at that early date he understood and applied the principle of wing warping to obtain lateral stability. It is remarkable, also, that with the exception of Marriott, no one else before or since has actually built and flown a combination heavier and lighter than air machine.—A. D.

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Growing Perfect Flowers in the Shade

(*Continued from page 27*)

plants. In this way the shade-loving plants find favorable conditions for growth under normal conditions.

These conditions may be repeated in the garden, provided that not all the fallen leaves of autumn are raked together and burned as is usually done.

Capetown mountain hill (Campanula rarpatica).

Let the leaves remain on the ground, help collect them together under the shade of the trees. If it is feared that the wind will carry the leaves away, cover the leaves with a thin layer of compost soil or leaf mold. This will hold them in place. In this way ideal conditions can be duplicated in the garden as they are found in nature. This method is sure and certain to give the garden in the shade the necessary foundation for its success.

Fallen leaves and leaf mold are not always the same. Mixed forests have certain definite plant growth which demand shade but which are not found in the coniferous forests nor in the oak forest. The type of humus found depends upon the plants and trees which grow in the region in question. Maple and locust are not so well adapted for the more common shade flowering undergrowths. Apple, oak, and many conifers, on the other hand, give them the best of growing conditions.

Flower producers among the growers in the shade are Rhododendron, Azalea, Laurel and the newer forms of colored *Astilbe*. The latter especially brings new pleasure in the shaded garden during the summer months. Of the more vigorous types the floral stalks may attain a height of a yard or more and more mature forms take on a tropical character in their growth. More delicate and not so hardy among the shade-enduring flower-producing plants are the *Begonia* and the Snowball (*Hortensia*).

At a time before the taller trees have produced their foliage quite a number of perennials will have come forth and shown their bright faces to the sun which shines between the still denuded branches with a strength sufficient to awake the sleeping perennials. Among those that are now found are *Arabis*, violets; *Gentiana*, helebores, alpine aster; *Trollius*, liverwort; *Hepatica* and the garden primroses, *Primula veris*, *acaulis*, and *elatior*. The *Anemone* and the evergreen ground myrtle, *Vinca*, are true plants of the shade. The Canadian anemone (*Anemone canadensis*) flowers and then remains green through the entire summer. *Asarum* is another plant of the shade and the European form (*A. europaeum*) grows in the deepest shade of the beech forest and even remains green throughout the winter. Thick green bolsters are formed by *A. virginicum* and *A. caudatum*, the latter not remaining green in this winter, but which is quite interesting due to its long fringed flowers. A delicate growth which will thrive excellently even in the humus of conifers is *Claytonia sibirica*. Once established, it sows its own seeds and will remain for years. The rose-colored flowers are developed through the year. In moist locations it is best to plant money-wort (*Lysimachia*), which forms a lawn-like growth and unfolds its yellow flowers readily. In a mixed forest the deepest shadows can be planted with *Mercurialis perennis*. It crawls rapidly along the ground and will cover quite an area in a short time. Another plant lawn-like character is *Saxifraga umbrosa*, producing delicate flowers. Still another is *Sedum spurium*, which will form a green carpet in the shadiest of spots.

Flowering perennials suited for the partial shade are not difficult to find. The majority have come from eastern Asia, others are newer forms of older types already under cultivation. Here we have the *Astilbe*, mentioned above, in many and diverse forms and with brightly colored flowers in various shades and tints. Then, too, there is columbine (*Aquilegia*) in many new varieties which will withstand shade excellently.

A European mauntain flawer (Saxifraga umbrosa).

The larkspurs. *Delphinium elatum*, will stand the effect of shade quite well, provided they get some sunlight. The hybrids derived from *D. elatum* and *D. chinensis*, which are quite loosely built, demand sunlight and must be placed in its full light. Placed in shaded situations slugs will soon destroy them. Many of the more vigorous asters will do quite well in light shade, the only exception being *Aster amellus*, which is not suited for this place. Quite a number of bell flowers (*Campanula*) are adapted for places that receive but little sunlight. When the shade is not too dense, then *C. latifolia*, *macrantha*, *trachelium* and *carpatica* will blossom during the early part of June. Other flowers that are open then are the lilies —*Lilium umbellatum*, *L. testaceum* and *L. croceum*. *Corydalis lutea* also withstands the effect of considerable shade quite well, although it will do best where the shade is not too heavy. The flowering period lasts from May into June.

The shaded parts of the garden have naturally not the quantity nor the quality of flowering plants that can be found in the sunnier parts. At the same time there is a distinction between shade due to the entire absence of the sun's rays and shade due to the crowns of taller trees. The latter is the most difficult to deal with, for not only the effect of shade is felt by the plants but the roots of the taller trees abstract all available food and moisture before the other smaller plants may have a chance to avail themselves of it. The fact is most evident where the nature of the ground is dry to begin with. In the valleys this is not so serious, since there is always more or less moisture present. The conditions of life for the shade-enduring plants can be materially aided, as has been stated, by providing plenty of humus, the fallen leaves of winter, which retains its moisture fairly tenaciously and so gives the shade-enduring plants the necessary water.

The Oracle

(*Continued from page 60*)

be to have a couple of knitting needles drilled to accommodate a small point. Balance the needles on the point and then show how the point is magnetized by touching it with a bar magnet. Prior to introduction of the bar magnet, loadstone was used. Reports would have it that loadstone compasses were also in operation, but it is questionable if they existed before the needle-type of magnetic compass.

You can also magnetize a needle and push it through two small pieces of cork and float the needle in a glass of water. This will demonstrate the second version, or improvement, of the compass.

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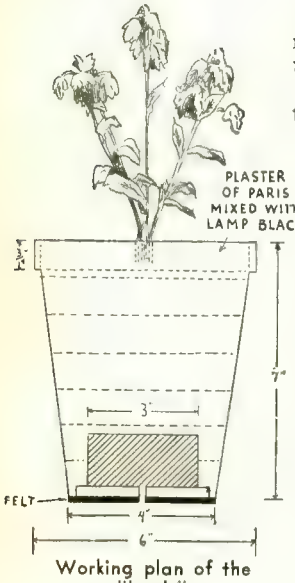
A Flower Pot Money Cache

(*Continued from page* 39)

down to round again. Shape the pot as shown, with a slight projecting rim about 1 inch high, and taper the piece down to 4 inches diameter at the bottom.

Carefully turn the false floor recess, ⅜ inch deep and ¼ of an inch from the edge, then cut out the interior 3 inches in diameter and to within an inch or less of the top. If desired, the job can be screwed to the large face plate so that the dead center can be backed away near the final inside cutting, and a neater job will result.

Plenty of sanding and rubbing with fine steel wool removed all roughness on the outside surface. Then walnut stain and two coats of clear lacquer were applied and well rubbed down. Final polish was applied by lightly rubbing with the hand.



Working plan of the "bank."

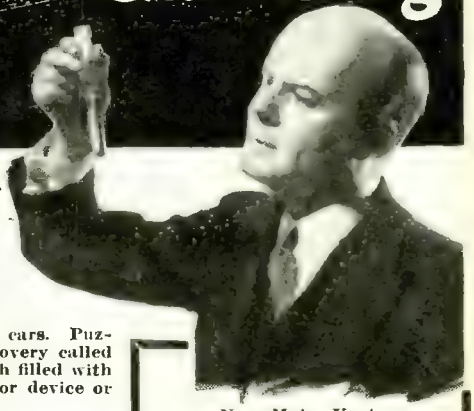
If you prefer a more natural imitation of the flower pot then you can use an opaque paint or lacquer in the desired color, although several applications will be needed to completely hide the wood, if each coat is polished.

Now cut out the false bottom from ⅜-inch ply or veneer on the band saw, cut a small slot through it, and fasten this in place with about 6 small screws ⅝ inch long, with the heads set flush with the lower surface to permit the felt to lie smooth. Run a line of liquid glue around the bottom, *outside* the false bottom, and also touch the bottom in a few places with glue. Then press some felt in place and trim off the edges. This will readily come off when you wish to empty the bank.

For the final deception, get a few stalks of suitable imitation flowers. The ten cent store variety will be ideal. Bore a shallow hole in the top for each stalk and seat it. Then mix up the plaster of paris with lamp black (soot from the furnace flue will do nicely), and after adding some water well stirred in, quickly build up the imitation earth around the plants. It can be left rough, or lined with a needle before setting, to imitate cracks in the earth.

Although the compartment is not large, it will house a surprising lot of coins. The dimensions for the pot can, of course, be varied to suit, and the money chamber need not be as large as shown on the drawing. That's optional with you.

Inventor Produces Mysterious "Gas Bug" That Will Save Gasoline



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You have known people like that, set in their ways and hide-bound by tradition. Good souls they are, fine, solid, substantial . . . but missing so much that they have every right to enjoy. Wouldn't you like to shake them awake . . . sweep the cobwebs from their mental horizons . . . give them the words like "new" and "latest" to replace the "olds" and "always"? If they would only read the advertisements!

New foods and balanced diets. Household appliances that add hours to the day. Stylish dresses at astonishingly reasonable cost. In fact, all up-to-date merchandise in complete array. That is the sort of news the advertisements bring you . . . new ways to do old things, new articles to replace the old . . . news!

Read the advertisements. It will pay you . . . in added enjoyment, and actual money saved.

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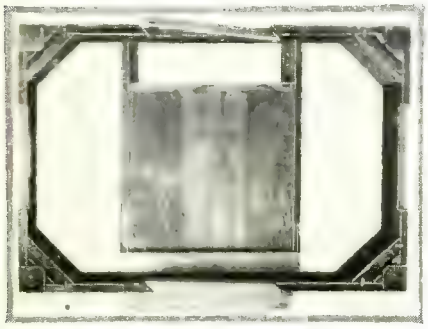
Converting a Kitchen Table into a Space-Saving Utility

(*Continued from page 57*)

screws across the table from rail to rail and a top with the four corners rounded was fastened to the cabinet. The projecting ends of this top were made to slip into the slides and the cabinet to be pushed into place.

The boss arrived on the job while we were putting the finishing touches to the cabinet and we very proudly lifted the leaves of the table, pulled out the ironing and biscuit boards and opened up the cabinet doors while she looked on and admired. When we had finished with the demonstration she expressed herself that there was just one thing lacking and this was that we should have one of those tile-like looking tops that one sees on cook tables nowadays. We scratched our head and wondered how it could be done, but a visit to the furniture store disclosed the secret that linoleum could be cemented to wood with a waterproof cement and that it made an excellent table covering, very like tile in appearance and really much nicer.



View of breadboard installation.

Some little time was spent in learning the ins and outs of the cementing process before we tried it on the table top, and we give these directions here for those who may wish to add the linoleum top to the table and cabinet.

First: Have the surface of the wood absolutely clean and free from dust.

Second: Spread special cement, which should be purchased along with the linoleum, on the cleaned wood.

Third: Lay a thickness of felt, which is also an accessory that goes along with the linoleum, on the cement and roll or press down firmly.

Fourth: Spread another coating of cement and lay the previously cut piece of linoleum in place on top of the felt and either press or clamp the linoleum firmly into contact with the felt and wood.

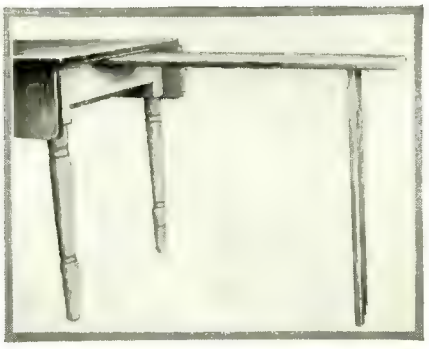
Fifth: Tack a brass binding strip after the cement has set around the edges to prevent the linoleum from pulling up. Linoleum should never be cemented to wood direct, due to the expansion and contraction that takes place in wood. The felt layer will take care of this and prevent trouble.

These tile-like tops add greatly to the appearance and usefulness of the finished job and they will last indefinitely; and then if an enamel of a shade to harmonize with the colors in the top can be secured to paint the wooden parts with, the table and cabinet will certainly do any kitchen justice.

An oilcloth covering can be used at a great deal less expense; or the top can be carefully surfaced, sanded, and then covered with an enamel finish.

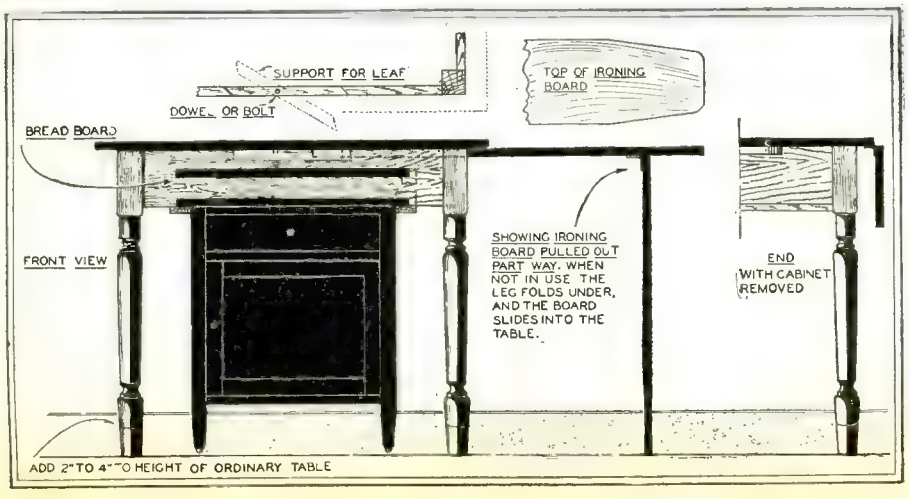
If the cabinet is to be filled with heavy utensils, drawer rollers can be used either on the bottom side of the cabinet top or in the slides. These rollers sit almost flush with the surface of the wood and facilitate sliding surfaces. The legs should be slightly short so that the feet will not touch the floor when the cabinet is in place and they should be fitted with rollers or glides.

The cabinet-table construction has many things to recommend it. One has a useful cabinet that is out of the way in space that would otherwise be wasted. When additional table space is needed the cabinet may be slipped from its berth and rolled to where it may be needed. It has doors on both sides and the compartments are easy of access.



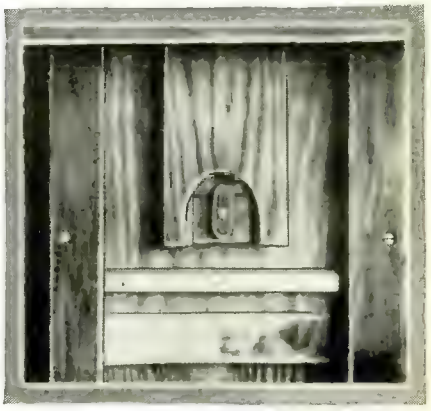
The ironing board, all ready for use.

Diagrammatic view of the converted table.


SUPPORT FOR LEAF
DOWEL OR BOLT
TOP OF IRONING BOARD
BREAD BOARD
FRONT VIEW
SHOWING IRONING BOARD PULLED OUT PART WAY. WHEN NOT IN USE THE LEG FOLDS UNDER, AND THE BOARD SLIDES INTO THE TABLE.
END WITH CABINET REMOVED
ADD 2" TO 4" TO HEIGHT OF ORDINARY TABLE

When the leaves are lifted on the table the size is considerably increased and there is ample knee, foot, and leg room for diners, in spite of the cabinet, and it can be used very nicely as a breakfast room piece of furniture.

The ironing board provides a convenient accessory that is always available at an instant's notice and when a little pressing is to be done it is not necessary to go and hunt up and set up the regular pressing equipment. If the kitchen table is permanently set, electric current can be run to it and an outlet placed in a convenient place on the table for the sad iron, percolator, waffle iron, or motorized kitchen equipment.



Leg of the ironing board folded under and out of the way.

The bread or cutting board slipped into place is always out of the dust and conveniently located when needed.

Due to difference in sizes of tables, the writer has not undertaken to give any dimensions on the working drawing. Nearly every home has an old kitchen table that could be worked over and made into an efficient article of home furnishing and the results in appearance and usefulness will well repay the home worker for his efforts in "revamping" the old kitchen table.

The Safety Valve

(*Continued from page 5*)

that the editor could not examine each one separately, and it is much easier to hand out rejection slips than to look for a worthwhile idea. The result is that the prize is awarded for some mediocre wrinkle that does not even deserve honorable mention.

My month would be a dead loss without SCIENCE AND INVENTION and I like it more and more. Keep up your good work.

S. M. SLINGERLAND,
San Pedro, Calif.

(Each and every wrinkle is examined carefully. Many are rejected because they have been published in previous issues or because they are plagiarized from existing books. -EDITOR.)

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Don't They Have the Queerest Jobs?

(*Continued from page 20*)

ing full course meals made entirely out of plaster of paris, clay and beeswax; and so on down a well-nigh inexhaustible list.

Imagine using a "vacuum cleaner" on a cow's back! Yet it's been done, and very recently. A group of government scientists stationed at Galesburg, Ill., had been making an intensive study of how best to remove grubs known as "warbles" from the shoulders of cattle. At first they tried to remove the pests by the slow and painstaking process of using forceps, removing the grubs one at a time. However, this method was extremely expensive. But the experts did not give up. They put their heads together, and the ultimate result was a "vacuum cleaner," built on an automobile trailer. It has four to six lines of suction hose and nozzles. When in operation a nozzle is placed over an ox-warble grub on the animal's back and the grub is drawn out through the opening in the skin.

Certainly one of the most unique jobs in the entire government falls to the lot of Frederick C. Lincoln of the Biological Survey. He is an expert on "daylight saving" birds and he has lately made these interesting discoveries:

The graceful Arctic terns, some of which breed close to the North Pole, are without doubt the champion globe trotters and "daylight saving" members of the bird world. Some individuals make an annual round trip of 22,000 miles from their breeding grounds to their Winter quarters and return. They also probably enjoy more hours of daylight than any other creature living today. Before they reach their breeding grounds in the Arctic the midnight sun has already disappeared, while during their sojourn in the Antarctic, daylight is continuous.

Talk about novelty! Here's a unique device invented by one of the greatest "odd-job" scientists in the world. Professor C. F. Marvin, chief of the U. S. Weather Bureau. The instrument actually enables a weather observer to look at clouds over airports at night and determine their height or the height of "ceiling," as the aviator terms it.

Two chemists of the Bureau of Chemistry and Soils recently developed a job for themselves that is so new in the field of science that it has no parallel anywhere in the world. This job consists in cultivating the despised mould, popularly considered to be entirely a destructive substance found all too frequently in the tops of jellied products.

However, the two chemists, Horace T. Herrick and Orville E. May, lately made an astonishing discovery to the effect that moulds may now be used in the making of an important health-giving product. By a new process developed by Herrick and May, moulds may be put to work to produce gluconic acid, used in making an expensive salt with highly important medicinal qualities. By the new method this salt is reduced in cost from $150 a pound to a mere 50 cents a pound. "This," points out Dr. Henry F. Knight, chief of the Bureau, "is an example of the manner in which the Bureau is using apparently useless organisms to create valuable chemicals."

Surely one of the queerest inventions in the world is the "olfactometer," which is able to test the smelling ability of certain kinds of insects. The novel device is the product of the ingenious brain of Dr. N. E. McIndoo of the Bureau of Entomology. He invented it especially to test the "smeller" of the Colorado potato beetle. With this apparatus he proved for the first time in history that odors from plants (not flowers) attract insects. Entomologists are finding improved olfactometers useful in determining just what odors in various plants attract certain insects. The specific odors are placed in the field or garden to attract insects to traps or other places where they can be destroyed conveniently.

An Expert Food Sculptress

Then there are the government experts on "pill-box" traps. The traps are ingenious affairs, made of ordinary pill boxes, which have proved to be unusually effective as a means of breaking up colonies of little red ants that from time to time invade the sacred pantries of the White House. The inventors of the traps are R. T. Cotton and G. W. Ellington of the U. S. Department of Agriculture. They took an ordinary pill box, removed the top, and cut out four small square holes from the inner collar. Next they poured a thin layer of hot paraffin inside the box to make it water-tight. When in use the top of the box is partially raised to expose the holes and allow the ants to enter. Poison bait then kills the insects.

Undoubtedly the prize job for women workers for Uncle Sam belongs to Margaret Roller, "food sculptress" of the Department of Agriculture. She devises entire meals, made of plaster of Paris, beeswax and oil paints, for important government exhibits. Her co-workers believe that this remarkable young woman has developed a technique without parallel either in this country or abroad. First of all, she points out, she cooks foods in the ordinary way, lets them cool, then begins to make model casts of each separate cooked dish. So realistic are her models that on the occasion of a recent exhibit at the Department of Agriculture, a little boy visitor, inspired by the tasty appearance of a well-browned sirloin steak, grabbed said steak, and was just about to take a sizable bite out of it when an attendant fortunately cut short the endeavor. Of course, the steak was one of Margaret Roller's famous imitations. Made of wax, it was supposed to represent in the exhibit the meat portion of a luscious meal that also included asparagus salad, shirred eggs, stuffed tomatoes and ice cream.

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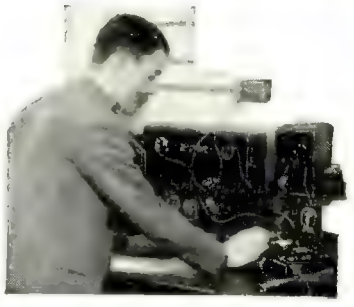

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Television Takes the Next Step

(*Continued from page 47*)

Electrons are emitted from the cathode mirror (the surface of which is photosensitive) in proportion to the amount of light falling on it, and these electrons are accelerated by a potential of the order of 500 volts which is applied to the anode screen, as shown in Fig. 2. Most of the electrons are projected into the equipotential region between the anode screen and the target, wherein they follow a helical path as already described, and recombine to form an electron image in the plane of the target. This electron image is then shifted by the two transverse magnetic fields so that the entire image is caused to move over the aperture in the target shield, thus achieving scanning of the image in a zigzag fashion.

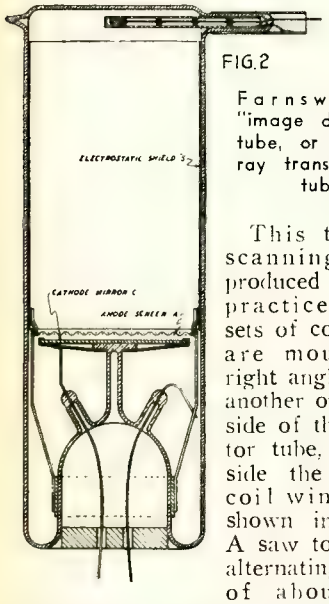


FIG.2

Farnsworth's "image dissector" tube, or cathode ray transmitting tube.

This transverse scanning field is produced in actual practice by two sets of coils which are mounted at right angles to one another on the outside of this dissector tube, and outside the focusing coil winding, as shown in Fig. 1. A saw tooth wave alternating current of about 3,000 cycles flows through one set of coils, and produces a horizontal deflection of the image. A 15 cycle current of similar wave form flows through the other set of coils and produce a vertical deflection of the image. The resultant path of the image, relative to the target structure, is as shown in Fig. 4. Thus, each individual square picture is scanned in 200 lines, 15 pictures are transmitted per second, and the amplifier which handles the output of the target or photoelectric cell must therefore be capable of handling a frequency band width of approximately 300 Kc.

The design and construction of an amplifier to handle such an enormous frequency band width is a gigantic problem in itself, but Farnsworth has solved it by making use of what he terms a system of "admittance neutralization," which permits input impedances (as well as interstage impedances) of as high as several megohms to be obtained up to frequencies as high as one million cycles, without distortion. Unfortunately, the patent situation does not permit of a detailed description of this amplifier, and its underlying principle, being published at this time.

At the receiving end the incoming picture impulses are transformed into a visible image by means of a form of cathode ray tube called by Farnsworth an oscillite. This is illustrated diagrammatically in Fig. 5 and in one of the accompanying photographs. It is of the hot cathode type.

The oscillite is similar in some respects to the kinescope constructed some time ago by Dr. Zworykin of the Westinghouse Co., but makes use of the magnetic focusing principle, and scanning is effected by means of two sets of coils mounted at right angles to one another, as in the transmitting dissector tube. The electron gun element has been designed with the object of driving the greatest possible number of electrons through an aperture of given size, and limiting the angle of this beam so that it can be easily focused. This element, shown in Fig. 6, consists of a helical filament, oxide-coated only on the inside. A shield is placed over this filament having in it a hole of the same diameter as the filament helix. The anode, which is tubular in form, is supported in front of the cathode, and midway between the filament shield and the anode there is mounted a ring grid, marked 22 in Fig. 7.

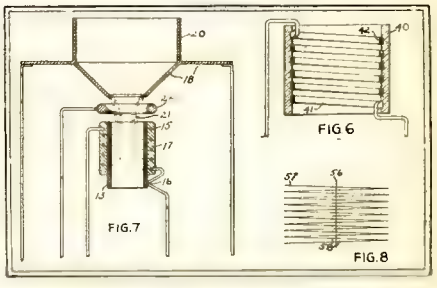
The advantage of this type of element is that the anode tube is mounted approximately at the focal point of the electrons leaving the emitter, or filament. The anode potential required to provide this focal point at the entrance to the anode tube may be any voltage between 1500 and 2500 volts for tubes in use at the time of writing. The current consumed is practically negligible.

In order to achieve synchronism, Farnsworth generates at the receiver two alternating currents of saw tooth wave form, identical with those used at the transmitter. These currents, of course, have to be synchronized with those at the transmitter. In order to do this, advantage is taken of the fact that these currents can be made to induce a strong voltage pulse into the picture frequency circuit during the steep part of their slope. These pulses are used at the receiving end to hold the local generators in step. These voltage pulses, which occur only during the interval between individual pictures, serve also to turn off the oscillite spot during the return part of its path, i.e., during the very steep part of the saw tooth wave cycle. (See dotted line, Fig. 4).

This system of synchronization, according to Farnsworth, is very simple and very effective. It does not require an additional communication channel for the synchronizing impulses, nor even any additional equipment such as filters, etc., to separate the synchronizing impulses from the picture frequency.

The reason for using a saw tooth wave form in preference to a pure sine wave for energizing the deflector coils is that if a sine wave current were used, a double picture would be produced at the receiver whenever the two currents were not in phase. The reason for this may be seen from Fig. 8. It will be seen that when the two currents are slightly out of phase the point producing the line (56) is shifted towards one side when the point is traveling across the picture in one direction, and towards the other side for its return trip, thus blurring the line. This effect is completely eliminated with saw tooth wave scanning currents.

Each scanning frequency is generated by means of a helium glow tube in combination with a small power tube used as an oscillator, and one stage of amplification. The glow tube has an electrode sealed into it which is coupled through a 10 mmfd. condenser to the picture frequency circuit. It is found in practice that the pulses present in this circuit lock the receiver oscillator tightly in step with that at the transmitter. A diagram of the receiver arrangements is given in Fig. 9, which shows the radio receiver (41) and the connection to the electron stream control element (47), and one of the two oscillator circuits which supply the deflector coils (30). The power required in the deflector coils for maximum size pictures may be generated by a small power tube. The amount of power required for the magnetic focusing coils is quite negligible.



Figs. 6 and 7—Details of the oscillite filament. Fig. 8—Illustrating why a saw-tooth wave is used for synchronizing.

Considerable work has been done by Farnsworth on the development of a 4-metre radio link, and the progress to date indicates that a quite satisfactory television service could be conducted on this wavelength over distances up to about 50 miles, providing proper care is taken in choosing the location of the transmitter. This involves so placing the transmitter that it will be almost visible from any part of the area which it is designed to serve, for only the ground or direct component of the wave can be relied upon to affect the receiver.

More successful results have been achieved by using wired radio as the channel of communication. It has been found to be perfectly feasible to modulate a 1000 Kc. carrier wave with a 300 Kc. picture frequency, and transmit it over a telephone line. The pictures so transmitted are practically as good as those seen on a monitoring receiver placed close to the transmitter. The voltage attenuation has been found

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to be about 45db. per mile for a standard No. 19 pair cable. With this attenuation it would probably be necessary to relay every few miles, but if an open wire circuit were to be used instead, Farnsworth is of the opinion that a television service by means of wired radio would come entirely within the range of possibility. The synchronizing impulses are, of course, also sent along the same telephone line, and voice frequencies may be put on the same line as well, by using another carrier of different frequency, thus confining the entire "see and hear" service to a single channel of communication.

A frequency band 300 Kc. in width can not, of course, be broadcast through a regular broadcasting station. Quite apart from the technical difficulties involved, broadcasting stations are confined to a channel only 10 Kc. wide.

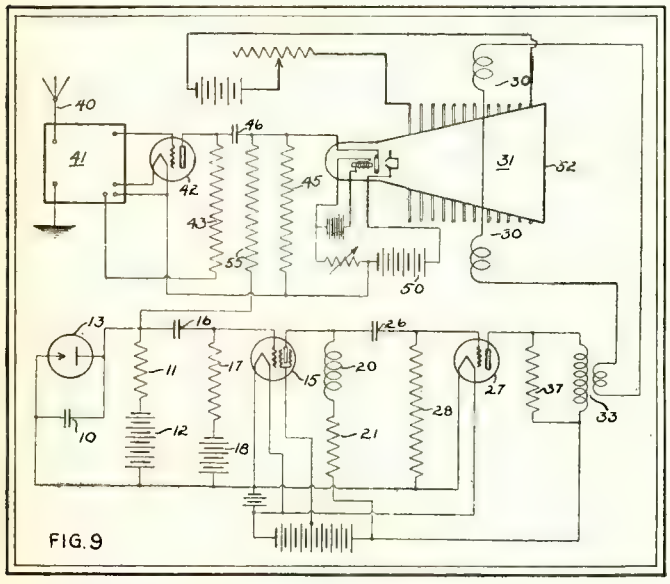

FIG. 9

Diagram of receiver circuit of the Farnsworth televisor.

However, having thus very ingeniously developed a special amplifier for very high frequencies, and means for transmitting those frequencies both by radio and by wire, Farnsworth has recently announced the invention of what he calls an "image compressor." Details of this have not yet been released, but it is understood that by means of this new development, part of the wide picture frequency band is suppressed before transmission so that the width of the frequency band which must actually be transmitted is only about 7 Kc. The suppressed part of the signal is replaced locally at the receiver. This development, like all his other inventions, was worked out by Farnsworth mathematically first, and then put into practice. It is his brilliance as a mathematician that has enabled this young Californian to make such good progress.

By applying the new transmission principle to speech currents as well, Farnsworth hopes to be able to transmit television signals on one side band of existing broadcasting stations, and speech on the other, thus providing a complete seeing and hearing service through the regular broadcasting stations.

As regards results, credible witnesses report that Farnsworth's images are better than the 72-line images produced by the Bell Telephone Laboratories' two-way television, which are unquestionably the best images produced to date by mechanical means. Furthermore, Farnsworth states that his images, when received by the "image compressor" method, are even better than when transmitted in the ordinary way by wire or radio. The images are about four inches square unmagnified.

Farnsworth expects to have apparatus on the market before the end of this year, and estimates that a complete unit, comprising televisor and radio receiver will cost about $250. An adaptor, comprising oscillite, synchronizing unit, and 2-tube A. F. amplifier, suitable for attachment to existing radio sets, should sell for about $100. The average life of the oscillite is 1000 hours, the cost of renewal $10 to $15, and the operating high voltage, obtainable from an A.C. unit, is 2000 volts. The essentials of the equipment are thus seen to be simple, reasonably cheap, and absolutely silent in operation.

Farnsworth has not, of course, provided the complete solution to the television problem; that is still a long way off. But he seems to have gone further, and on more solid ground, than any other investigator whose results have been made public to date, and his future activities merit the serious attention of all who take more than a passing interest in the subject.

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The editors have received thousands of different designs of perpetual motion devices, and have received hundreds of circular letters soliciting finances for the building of perpetual motion machines.

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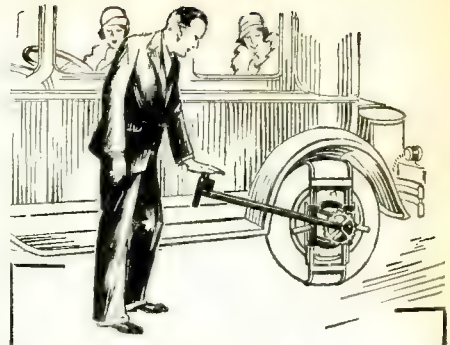
Most of the shares of stock for these perpetual motion machines are being sold at a rate of $1.00 per share, although some inventors are trying to sell shares of stock at $100.00 per share.

Therefore, the editors of this publication say, "Just come in and show us—merely SHOW us—a working model of a perpetual motion machine and we will give you $5,000.00. But the machine must not be made to operate by tides, winds, waterpower, natural evaporation or humidity. It must be perpetual motion."



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Hunting with African Giants and Pygmies

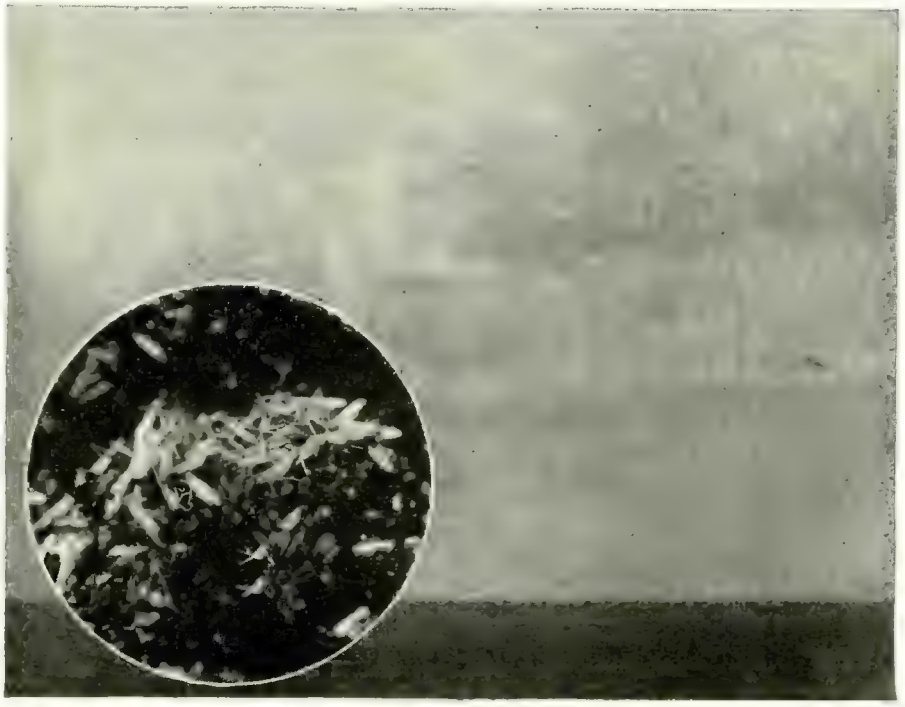
(*Continued from page* 16)

mous storm of plagues the locusts covered the earth in a ravenous horde, eating every blade of grass in their path. Every animal leaves the stricken area. And hundreds die in their frantic efforts to shake off the pests. Clouds of countless billions literally hide the sun and every modern resource of science has failed to combat them, for no one knows from whence they came or where they go.

As if led by the hand of a higher power the wildebeeste know by instinct, that the only way to escape disaster is by taking a course at right angles to the wind, because the locust fly with the wind. It is estimated that there are about 60,000 locusts to the square yard and a swarm such as this covers millions and millions of square yards. Unlike the Bible plague of old, the present plague is no respector of race, creed or country. The stampeding wildebeeste raise clouds of giant hoppers which have settled on the ground. The frantic animals must travel more than fifty miles through insect storm before they can eat or drink again. In the evening locusts continue to come down from the sky in millions, settling on every bit of green vegetation in the countryside. They break strong branches of trees by the sheer weight of their countless numbers. And the ground is covered with a blanket at least six inches deep. All through the night they eat—eat—eat every blade of grass, every leaf of the trees and in the morning this beautiful country is transformed into a bleak and barren desert.

To our knowledge we are the first in the history of motion pictures to record and photograph this phenomenon of nature.

With their crops and food supply ruined over night, whole tribes of natives have been caught in a scourge like this to die of starvation before they could get out of the devastated area.



Part of a locust swarm, Tanganyika. Inset—Locusts feeding on a tree.

It was our good fortune that the truck contained sufficient food to carry us out of this ravaged country to our next supply station.

It was shortly after this on a bright April day that we left Nairobi for our long trek to the west coast. Arriving at Jinja early one morning we were quartered at the rest house. It stands on a bluff below which roars the Ripon Falls, source of the Victoria Nile. Here it was that the explorer Spike stood on July 28th, 1862, after tracing out the Nile to its beginning in Victoria Nyanza.

Uganda is the land of bicycles. It appears as if every Buganda in Uganda has a bike. We met them on the roads with their wives riding behind balancing bundles on their heads, while in the towns and villages the streets were crowded with them. It was a strange sight to pass grass huts set among banana groves with little black children playing about, and there to see several bicycles leaning up against a tree or the hut walls. Somebody has said that transportation is the beginning of civilization, and here we have the Buganda in the bicycle age.

Our trip down the Nile was one of abounding interest. On the western side we could see the villages of the Lugwari and Alulu tribes, while the eastern bank proved to be unpeopled, a closed area, to both white and black, for its swamps are deadly with sleeping sickness.

The land teemed with game. Families of hippopotami disported near the banks, while crocodiles yawned in the sun. The sacred ibis of Egypt flew about in thousands and covered the trees along both shores like white blossoms. At near to noon my boy shouted, "tembo Bwana," and sure enough there were four elephants slowly walking along the water's edge. They wheeled and faced us with trunks flung high, then turned to amble away toward the high swamp grass.

The boat stopped at a wood station on the west bank, called Pakwach, and while the naked men and women of the village were putting the fuel on board, we had a look around and decided to land. What happened to us from that time until we reached our camp some 160 miles away, was plenty!

Pulling the trucks with ropes over swinging bridges of bamboo that spanned deep gorges, climbing steep hills through soft dirt, digging out of muddy stream beds, meeting a very interesting people, buying chickens four for a shilling and eggs fifty for the same sum, these are things that stand out in the mental picture of that famous trek from Pakwach to Rhino Camp.

We spent a few days at this place photographing the rare white rhinoceros, that here still tramps through the torrid heat. Elephant, black rhino, Uganda Cob, waterbuck and thousands of buffalo also live near the ancient river. Where hippopotami and crocodiles disported in the water; where huge pythons crawled through the papyrus swamp that stretched to the horizon from the opposite river bank; where many leopards and an occasional lion paid us a visit, such a place was Rhino Camp.

Here also came mosquitoes in countless millions to sing the song of fever and death outside our net all night long. These little messengers of the devil that come after dark are more to be feared than the animals that claw and bite, or toss and tramp.

From the Nile camp we motored to Arua and then made our official entrance into the Belgian Congo at Arua. A few days of travel through an always changing country brought us to Gumbari on the Bomokandi river.

Here the young Belgian Administrator gave me a guide and permission to enter the Ituri forest in search of pygmies. We penetrated deep into the jungle and made headquarters in a large clearing, where our guide managed to collect over one hundred of these little people. Here we spent many weeks crammed full of interest and work, being successful in securing remarkable pictures.

Many of them clustered about me as I worked at the typewriter; they would stand there by the hour without a single sound. Like children they stood and gazed, marveling at the wondrous thing that made a clicking sound and

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strung odd looking marks one after another over a blank white surface.

This pygmy is called "tiki-tiki" by some, other names by many, but the real name of the tribe, according to the chiefs, is "Ifi," and I believe I am the first to record their true name. I measured several of the men and women, finding the women averaged two and one-half inches shorter than the men. The tallest man measured fifty-seven inches and the shortest fifty inches. The average for the twelve of each sex measured was: for the men, four feet seven inches, and for the women four feet four and one-half inches. The tallest woman was fifty-six inches in height and the shortest fifty inches. They rarely weigh more than seventy-five pounds. Truly a small race.

The chief told me by means of sticks laid on the ground that there were

Asanga, chief of the pygmy tribe of Ifi

about ten thousand of the Ifi tribesmen. They live in small clans of from 25 to 50 souls over which a sub-chief rules. Some of these pygmy chiefs, like Asanga himself, belong to families which have ruled for centuries. The pygmy is omnivorous: his forest abounds in wild fruits and roots, while the animal life is fairly abundant. Being keen trackers and accomplished hunters they have no difficulty in keeping the meat pot boiling, and not being fastidious about their food, you will find such tidbits as snakes, lizards, beetles and grubs all being boiled up together. They consider all such both tasty and nourishing.

The pygmies have practiced companionate marriage for centuries—long before Judge Lindsey was ever heard of. If a marriage doesn't take after a year's try-out, they start all over again with a new wife. No one is allowed more than one wife at a time, except the king. He gets two, for safety's sake—to insure a son and future king.

These pygmean people proved to be the most interesting Africans we had so far met in our wanderings. In comparing them with natives of Bantu stock, I believe they are capable of more real thought and I think they would be easier to teach the arts and crafts at the missions. It is doubtful, however, if they will ever become subject to the white man's civilization, for a few days with him and they get itchy feet for the forest paths.

They shoot very accurately with poisoned arrows but depend more on the poison than the force. These tiny people kill a huge elephant with these small arrows, but it takes three or four days for the poison to take effect. After the elephant is hit, they follow him through the dense jungle until he dies.

From this point we made side trips to visit the giants of the Sara river region, and the Ubangi women who wear disks in their lips at the strange village of Kiya Be. There is much of unusual interest about this district, both in native and animal life, and it has the added attraction of being a place that is seldom visited.

The custom of inserting disks in the lips was commenced as part of a plan to save their tribe from extermination. Without this disfigurement they are the finest looking black women in their part of Africa. Behind this fact lies the reason for all the woes of the clan. In the days of slave raiding, when Arab bands swept out of the desert in their quest for black ivory, they never failed to call upon the Sara Kyabe, because on account of their exceptional beauty these women brought the highest prices on the slave markets. The product eventually became so scarce that even the girl babies were taken, to be brought up by the Arab women until old enough to sell. In the raids upon their villages, many of the men were killed, so between this killing of the men and the stealing of women, the tribe was nearly wiped out. Of course, slave raiding no longer exists, but they continue the practice of disfigurement because the custom is now so long established that no woman is considered attractive without a large lip.

The lip is pierced when the girl is a baby and it is stretched year after year, wider and wider around a circle of wood like a hoop around a barrel. As the women grow older the size of the disc increases until some of them carry circles 10 inches in diameter. The older the woman the larger the disc, and the higher her social standing.

The French Government is doing its best to stamp out this practice of the disks; also the devil worship among neighboring tribes. The undertaking is a gigantic one, but after all it is only one of the millions of problems which the white man must overcome if he wishes to conquer the vast continent of Africa.

We endured many hardships after leaving this strange village of Kiya Be, before we eventually reached our destination at Lagos, Nigeria, where on July 30th, 1929, we crept slowly over the ancient bridge that connects Lagos Island to the mainland, thus completing the first trans-African journey.

The distance from the East to the West coast was 5545 miles excluding side trips, but we had traversed 13,282 miles of veldt, swamp, jungle, mountain and desert since leaving Mombasa.

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For Real Sport—Try Archery

(*Continued from page* 43)

after your bow is trimmed to shape.

Select a piece of wood for the bow that has its grain running straight through its length, parallel with the sides, back and belly. The best wood for the bow is lemon wood, though hickory, yew, Osage orange, iron wood and ash are also good.

Trim the corners off the belly of the bow until it is rounded as illustrated. Leave the handle nearly square, just smooth the edges a bit. Start trimming the bow just inside the lines that mark off the position of the handle. Note that the handle is offset and not exactly in the center of the bow and that the longest end is the top of the bow. When trimming the bow take off just a small amount at a time and test the bow frequently so that your bow will not get out of shape. It is very easy to warp a bow or have it bulge in spots by not trimming it properly.

Stringing the Bow

Cut the nocks in the ends of the bow, making the bottom of the nocks, that is the ends on the back of the bow, 1¼" from the ends of the bow. File them in with a small rat-tail file and smooth off all sharp edges.

The bow string is made of heavy Irish linen cord, ⅛" thick or can be twisted and made up with smaller linen cord. In one end make an eye-splice or sailor's knot and whip the ends. In the other end make a timber hitch or Bowyer's knot. Adjust the string to the correct length so that when your bow is braced the "mele" is equal numerically in inches to the length of the bow in feet, viz: If the bow is 6' long the "mele" should be 6". Brace your bow, the end of the string with the eye-splice going around the top end, the other end being permanently secured with the timber hitch. If the bow is satisfactory, drill a small hole in the top end of it and above the nock about half way between the end of the bow and the nock. This is for the ribbon. Then take off the string, sandpaper the bow, put on the six whippings and the heavy cord handle as illustrated, first applying a coating of waterproof glue to the bow before putting on the whippings. The handle may be covered with leather instead of twine. I dyed my bow and arrows a light green. As a rule bows and arrows are just given a couple of coats of varnish. Use a spar varnish and sandpaper or rub down with wire wool between coats. The next thing to do is to put the string back on the bow and whip the string for about two inches directly opposite the spot where the arrow crosses the stave. Before wrapping on the whipping apply a coating of waterproof glue and last wax the cord with bee's wax from one end to the other.

The arrows come next. For a bow six feet long, arrows 28 inches long are the proper length. Arrows are best made of straight-grained pine, but nearly any kind of wood will do. Ordinary doweling is suitable. Make them 28" long by ¼" in diameter. The arrow heads or ferrules may be ordered from an archery supply house or may be made by melting the lead out of steel-jacketed 30-30 rifle bullets. Another way to make a good head is to buy pencil caps in the ten-cent store. These caps look very much like the end of a bullet, the only difference is that they have a slot in their sides and are not as heavy. The slot on the side of them must be sawed off and then filed smooth before the head is put on the shaft.

Taper the ends of the shafts as illustrated and fit the arrow heads or ferrules. These must fit snugly. If they do not, drill a small hole through the ferrule and the shaft and put a small pin through the hole and file smooth. Before you go any further see that the shafts are all driven into the heads as far as they will go. Then measure from the ends of the ferrules to the other ends of the shafts, marking them off twenty-eight inches. Then make notches in the ends of each of the shafts, ⅛" wide by ¼" deep. Make the notches quarter the grain of the wood so that the pull of the bow will not split them. Sandpaper the ends of the shafts round and smooth.

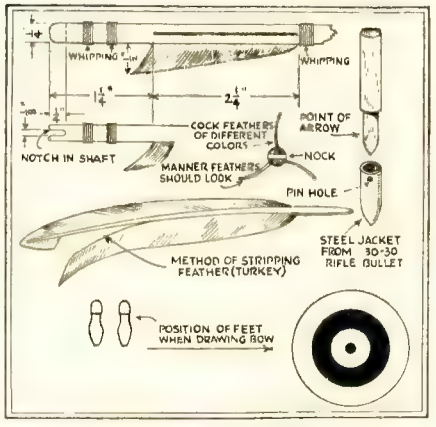

Diagram shows arrow details and position of feet when drawing bow.

Put on the whippings as pictured in the diagram. The whippings are of heavy silk thread and are made in the same manner as the whippings on a fishing rod, golf stick or tennis racket. The crest of the archer is indicated by the colors of the whipping on the arrows. Turkey red is a good color and makes an attractive whipping.

The feathers are goose or turkey feathers and can be got from the butcher. Take your feathers and hold them over a steaming kettle and then run them through your fingers to straighten them out. Hold them with one hand and strip them with the other. A thin fibre, a part of the feather's stem, will tear off with the feather, and this is what supports the feather on the shaft. Cut the feathers 2¼" long. Discard the ends of the feathers as they are not straight enough to be used. The first feather to be put on the shaft is the "cock" feather. Dye it a different color than the other two feathers and glue it on with waterproof glue and at right angles to the notch in the end of the shaft. The back end of the feathers should start 1¼" from the end of the shaft. After your cock feather is glued on, glue on the other two feathers. Do not spiral the feathers around the shaft, but run them straight down the shaft. Use feathers from the same wing of the bird for each shaft. If the feathers do not stay where you put them, pin them down until the glue sets. After the glue is dry, give them two coats of spar varnish, rubbing lightly between coats with OO sandpaper or wire wool. If you wish to color them stain them before applying the varnish. Johnson's wood dye is very good for this and it can be bought in a variety of colors. My arrows are green. Now set aside your bow and arrows and make the target.

The first thing that you need is straw. Bind the straw with heavy cord and make it in long bundle about six inches in thickness. Pack the straw tight. It will resemble a long snake. Then coil it up and lash one circle to the other with cord. Make your target three or four feet in diameter. Then cut two circular pieces of burlap the same diameter as your target. Cut a strip of burlap six inches wide or a little wider, allowing for sewing. Make this strip 3.1416 times the diameter of the circle or approximately 10 feet long for a 3 feet target and 13 feet long for a 4 feet target. Sew the strip of burlap to the two circular pieces, put the target inside this cover, finish sewing and then paint on the target rings. Make a stand for the target in the shape of an artist's easel. Put your target on it. Then get your bow, put a red ribbon in the hole in the top end, tie it, string your bow and then see if you're a modern Robin Hood.

New Tools You Can Easily Make

(*Continued from page* 53)

end, and two or three more into the pulley. The bolt spur should project a trifle more than the others in order to spot the disc center mark.

Protective supplementary jaws for a vise are subject to such severe usage that their short life of usefulness does not always warrant the making of them.

So primitively simple is the suggestion detailed in Fig. 5 that it is conveniently possible to make several pairs of different metals such as soft steel, brass, aluminum and lead.

Procure two short lengths of the angle metal required, and firmly clamp them face to face in the vise. Then hammer down the top faces to conform with the shape of the vise jaw tops.

To use, amply smear the inner faces of the dummy jaws with heavy grease. This will hold them to the vise jaws with surprising tenacity—in fact, it is possible to remove them only by sliding sideways.

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Scientific Aids to Your Comfort

(*Continued from page* 40)

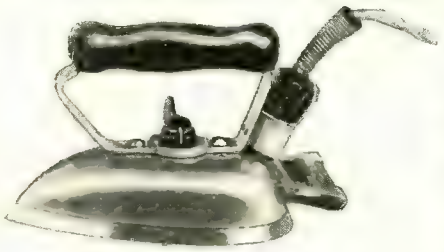
to remove the tarnish that never fails to appear.

This chest, which has special compartments for knives, forks, and spoons, will prevent the silverware it contains from loosing its lustre. No unwanted moisture will penetrate its confines. The box is of a dull gray color, quite attractive in appearance, conveniently sized to accommodate a good supply of cutlery, and so modestly priced that it is within the reach of all. Tested and approved in our laboratory

Individual Wardrobe for Baby

HERE is a costumer specially devised for children between the ages of 2 and 6. It is unbreakable, conveniently shaped so that the child can use it easily, and takes up very little space.

The circular tray at the bottom may be used for bathrobe, pajamas, bedroom slippers, shoes and rubbers. The bar in the middle for knickers, trousers, ties, underwear and socks. The coat-hanger top is for dresses, shirts or a coat. And your little son or daughter can hang his things up without any help. Everything will be together, ready for immediate use. Tested and approved in our laboratory.



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For the Home Machinist

(*Continued from page* 51)

grooving tool is that shown in Fig. 3. Here the width of cutting edge is maintained by means of a tapered pin. The pin spreads the nose of the tool so that it is brought back to dimension after grinding. Almost any discarded tool can be salvaged by annealing, slotting, and reaming for a commercial taper pin. Then it should be retempered.

While the example given is of a grooving tool, there are other instances in which it is necessary to provide adjustment in cutting tools. Before making up tools for any job the effect of wear should be considered fully, and if required, the tool should be made to allow for future adjustment.

Every shop is not fitted with large vises. When the work is too wide for the vise, the capacity of the vise jaws can be increased with jaw pins. This method is illustrated in Fig. 4.

The use of four small pieces of drill rod, slipped into four drilled holes in the vise jaws, increases the vise capacity. It is also possible with these drilled holes to use hook shaped pieces of drill rod to accommodate even larger work, as shown, as an alternate type of pin. While the use of this means does not allow for very heavy clamping, it is excellent for light filing and fitting up work.

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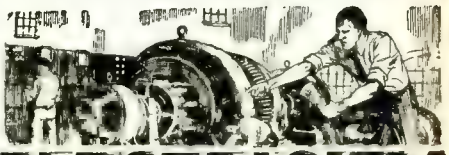

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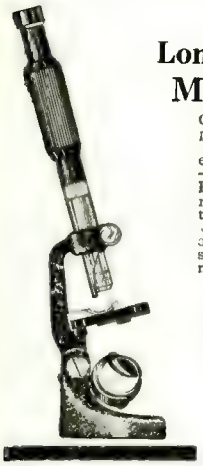

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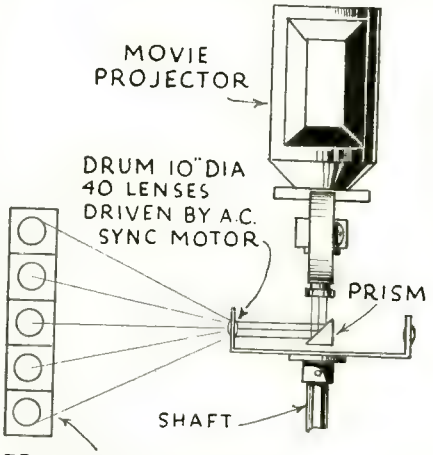
London Looks in at New Television Departure

(*Continued from page 21*)

scanning lines were slightly curved when, by a slight rearrangement of the apparatus, they might have been straight. (2) A very bad flicker which was very trying to the eyes in a demonstration lasting some 15 minutes. This also could have been greatly reduced. (3) Adjacent zones were not



Diagrammatic sketch of the H.M.V. transmitter.

properly aligned, and (4) there was a general inequality of "overall" brilliancy of the five different zones of the picture, which was particularly noticeable at the boundaries of the five vertical sections. This was no doubt due to small differences in the adjustment of the five amplifier and line circuits. Otherwise the brilliancy of the picture was good and equal to that given by the ordinary small home movie projector.

As regards detail, it was possible to read advertisements on hoardings and the sides of buses, and to distinguish the movements of wheels and persons. By further reducing the flicker it should be easy to read car number plates.

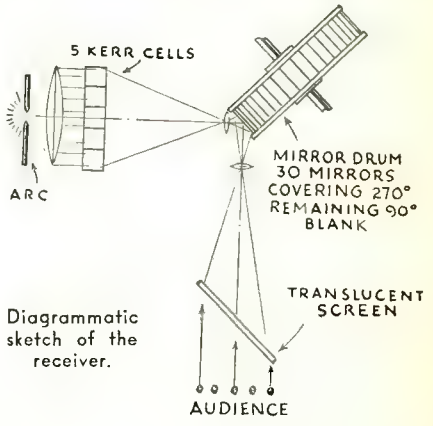
The synchronizing, which uses a separate channel, and is by phonic-wheel type motors, was very efficient and kept the picture rock-steady. Special precautions were taken to prevent any jerkiness inherent in the drive to the film gate, being transmitted to the lens drum at the transmitting end and thus causing its speed to deviate even slightly. A form of cushion drive, heavily damped with thick grease, was used for this purpose.

The transmitter consisted of an ordinary Simplex movie projector, with shutter removed, and a ten-inch lens drum carrying a spiral of 40 lenses. A prism placed in front of the projector bent the rays of light from the projector at right angles and through the lenses of the drum. After passing through the lens drum the light fell on a row of five photo-electric cells, each of which had its own individual amplifier feeding into one of the five wire channels. The photo-electric cells employed were developed by the Gramophone Company, and were of the caesium-on-copper type, and *not* gas-filled. These cells have the unusually high sensitivity (for vacuum-type cells) of 48.3 microamperes per lumen, which claim was backed up by a National Physical Laboratory certificate to that effect.

During transmission the film passed intermittently through the projector, being scanned while actually being shifted from one frame to another.

At the receiver an ordinary arc projector provided the source of light, which was modulated by the incoming image signals by passing through five sets of Kerr Cells and crossed Nicol prisms, similar to the single Kerr Cell-nicol-prism combination used last year by Dr. E. F. W. Alexanderson when he demonstrated the reception of television on a six-foot screen. The five cells, each dealing with the signals coming in on one of the five channels, i.e., representing one of the five zones of the picture, were arranged in line and did not occupy more than three inches over all.

After passing through the five Kerr Cells, the light beams were focused on a ten-inch mirror drum upon which were mounted in staggered formation thirty polished steel mirrors, each about two inches long. This drum was mounted at an angle of 45 degrees to the light source, which fact accounted for the curved appearance of the scanning lines. To correct for the intermittent movement of the film at the transmitter, only 30 mirrors were used, instead of 40, and these 30 mirrors were mounted around 270 degrees of the periphery of the drum, leaving 90 degrees blank. This explains the bad flicker of the received image, for the image was on the screen only 75 per cent. of the time. During the remaining 25 per cent. of the time the screen was blank.



Diagrammatic sketch of the receiver.

This fault could be overcome by using at the transmitter one of the German shutterless projectors which are available, and which are used by both the Baird and Jenkins television companies.

From the mirror drum the light beams were reflected to a translucent screen without further lens magnification. Actually, this screen was arranged vertically, but at an angle of

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about 45 degrees to the line of vision of the audience. Presumably this was done in order to make the faulty alignment of the different zones, and the disparity in brilliance between zones, less noticeable. A potential of 800 volts or more was necessary for operating the Kerr Cells.

In judging the results, in so far as they show improvement, it must be borne in mind that standard movie film was used and not actual living subjects, admittedly a much easier problem to handle. Also, six wire links connected transmitter and receiver, and no hope can be held out that a lesser number of links can be used, or that such a number of radio links will become available in the near future, so that this system of television can be broadcast. Nevertheless, it is my considered opinion that the demonstration, as such, definitely marks a stage of achievement in practical television which I have not been privileged to witness before.

Poisoning Trees to Make Indestructible Piles

(*Continued from page* 30)

vals holes are bored to the center of the tree. The tree is then encircled with two crescent shaped pipes bristling with nozzles projecting from the inside of the crescent. Each of these nozzles is fitted into a previously bored hole in the trunk of the tree. Leading to the crescents are feed pipes connected to a reservoir tank placed on top of a portable platform about fifteen feet high. This tank may be made large enough to treat two or more trees at the same time. The compound of copper and arsenic, held in solution by a volatile solvent, drains into the trunk of the tree by gravity. There it is picked up by the circulatory system and carried to every cranny of the trunk from top to bottom. After the poison reaches the cells, the volatile solvent evaporates and precipitates the copper and arsenic into the tree tissue. Tests have shown that the poison becomes, apparently, a part of the tree, and cannot well be leached out in water. After from 24 to 72 hours or so, the tree is dead and ready for cutting.

Tests Prove Successful

Tests of the new process have been under way for several years with the cooperation of the Southern Pacific Railroad Company. Trees have been injected on timber lands near Fort Bragg, California, and then cut for piles and telephone poles. Through laboratory analysis it has been shown that the poison, though less than at the base of the tree, reaches the top of the trunk in amounts sufficiently toxic to kill any organism boring into or living on it. Some of the telephone poles have been set out in swampy ground where fungus attack is prevalent. Others have been set out in the Coachella Valley where termites are particularly active; and piles have been anchored just above the mud along the Southern Pacific Mole in San Francisco Bay. In each case, untreated timbers, to serve as controls, have been set up or anchored alongside of the test timbers. After two or more years of exposure, Dean Lipman states, the treated timbers show little or no signs of attack, while the untreated timbers give evidence of various stages of deterioration. The poles set up in swampy ground have been in position for four years without damage, while controls are, in some cases, half rotted away.

It is interesting to note that when the University of California and the inventors applied for a patent they found many patents for injecting living trees, including one designed to color the wood for fine cabinet work, but none for the purpose of protecting the wood from destruction. The injection of trees for the purpose of treating *chlorosis* or iron deficiency was tried in Germany fifty years ago, and has been tried at various times since in America. Dean Lipman was the first to apply the injection method to treatment of this disease in California, and has been successful in saving thousands of fruit trees. He also tried to kill the bacteria causing pear blight by this method, but without success.

However, it was while working on this problem that he developed the improved, rapid method of injecting an entire tree that has been applied to the preservation of its wood. The idea of adapting the injection method first came to him about eight years ago as a result of his work on fruit tree diseases and of his membership on the San Francisco Bay Marine Piling Committee which was investigating the tremendous losses occasioned by marine borers on the Pacific Coast, and studying various control measures. The task of trying out his idea and of perfecting a technique for the application of the injection method to this problem was turned over to Mr. Gordon, at that time a graduate student at the university.

Dean Lipman and Gordon have given a half interest in the patent to the University, and Dean Lipman has also set aside the quarter interest which remained in his name as an endowment for research at the University. It is expected that the patents will be leased or sold to some business organization for trial and development, in which case three-quarters of the royalties will go toward research.

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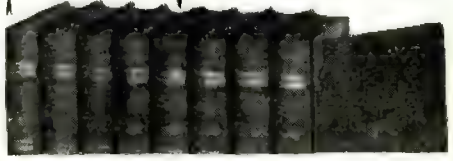

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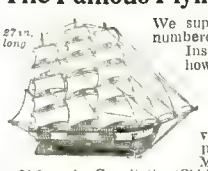

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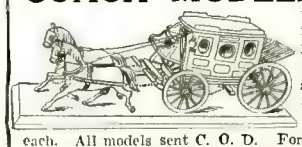

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Cosmic Bullets

(*Continued from page* 41)

underground, is likely to dissolve enough radium-bearing material to become radioactive on its own account—and since radium has an electrifying power all its own, the combined action of radium and penetrating radiation would have confused the experiments.

But what is this mysterious ray, powerful enough to pass through our atmosphere and some 45 feet of water, equivalent, in all, to about six feet of lead? In comparison the well-known penetrative power of X-rays, which are completely stopped by metal the thickness of a coin, is insignificant. To a cosmic ray the densest of terrestrial matter appears but the coarsest of sieves. Two possible solutions have been suggested. X-rays, light and radio waves are similar in character. They differ only in length of the waves (Figure 3). The waves of X-rays are small enough to slip through the interstices between the atoms. Cosmic radiation, therefore, may be nothing more than "super X-rays." Or it may possibly consist of high-speed electrons. In either case it is quite proper to speak of "cosmic bullets," since super X-rays, as well as electrons, exhibit certain properties characteristic of bullets. In other words, if the penetrating radiation is wave form, we can regard each "bullet" as made up of a bundle of vibrations. There would be one very marked difference, however, between the behavior of waves and electrons. The former would be entirely unaffected by the earth's magnetic field while the latter would be deflected and tend to hit the earth in greater numbers in the region of the magnetic poles (Figure 4).

Destruction through Cosmic Radiation

To decide between the two views, Millikan and Cameron made tests at a lake within 730 miles of the north magnetic pole. Since they found no measurable difference between the intensity at this high latitude and at the much lower latitudes of their earlier studies, it became reasonably certain that the super-X-ray theory was correct.

All atoms are electrical in nature. In the normal state an atom possesses the same number of positive (protons) and negative (electrons) units, so that the structure is neutral as a whole. Under certain conditions, however, electrons can be torn from the main body of the atom, which is then said to be ionized. An atmosphere "full of electricity" is simply one that contains many ionized atoms. Investigation reveals that an individual cosmic bullet, striking an atom, tears off one or more electrons, which move away with tremendous velocity. These high-speed electrons have a greater penetrating power even than the original cosmic ray. Every atom struck by one is ionized and the runaway electron dashes on, losing energy at each collision until, finally, even the fastest of them have come to rest after passing through a mass equivalent to the lake-depth of 45 feet. In our own bodies about 100 million atoms are thus ionized every second—a true devastation. Going indoors reduces this figure but little, since the shielding effect of the roof and ceilings is small. Sir James Jeans points out that cosmic radiation is, in a sense, one of the most significant facts of existence. The rays may be necessary for life or they may be killing us. Either view is somewhat extreme. If all the atoms ionized in the body of a person during his entire life could be collected, they would form a particle no larger than the smallest speck of dust barely visible to the human eye—so small is an atom.

Is the Universe a Perpetual Motion Machine?

That cosmic radiation probably does not come from the stars is shown by the fact that its intensity is apparently the same, whether the sun, our nearest star, is above the horizon or not. Millikan and Cameron have suggested that it originates in the vast regions of space between the stars. The stars have been pouring out light and heat for billions of years and most of this is still winging its way around the universe. Atoms, too, occasionally escape from stars and nebulæ, so that interstellar space is far from being a perfect vacuum. *If,* somewhere, some time, four hydrogen atoms were to get together and form a single atom of helium, we know that a ray not unlike a cosmic bullet would be produced. This view holds that cosmic radiation consists of the "birth-cries" of infant atoms, heralding that matter is being created out in the depths of space.

The heat and light radiated by the heavenly bodies is forever lost to them. This process cannot keep up forever, since their source of energy cannot be infinite. The stars are inevitably dying; the universe is running down and, unless someone or something comes along and "gives it another wind," we can foresee the day when the sun and stars will grow cold and dead. If Millikan and Cameron are right, we may hope that new stars will eventually replace the dying embers. The universe would thus be "self-winding." Anyone whose philosophical background is such that the picture of a dead universe, however far ahead the scientist may fix the day of its decease, seems pessimistic will probably welcome this view. Nor can science speak with certainty against it, for we know so little about how atoms are born.

On the view of Millikan and Cameron, the universe is a sort of perpetual motion machine. Eddington thinks it unlikely that Nature, having forbidden processes of this sort in ordinary experience, would turn around and adopt it for its own mechanism. The decree against perpetual motion is, however, not without a loophole. The atoms and radiation that form the universe are continually being "shuffled." The present state of affairs, with so much radiation concentrated inside the stars, is rather improbable. The mere fact of sunlight is assurance that the "shuffling" process is going on. A brand-

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new pack of playing cards has all the suits arranged in sequence. The chances that this might occur with random shuffling is small, but it will *inevitably* happen if the cards are shuffled a sufficient number of times. The same is true of the universe. With *infinite* time at its disposal, there is a chance, approaching certainty, that a given arrangement of material will eventually recur. It is surprising, however, that we should be able to see Nature "stacking the deck," when shuffling processes are much more probable. If Millikan and Cameron are right, we are forced to conclude that Nature is a dishonest dealer. It seems more likely that cosmic radiation should arise in the shuffling processes. We should prefer to believe that a cosmic vibration is the "death-rattle" of an atom, suddenly annihilated, rather than the "birth-cry" of an infant particle. But our uncertainty is born of ignorance. Within a decade or so we may be able to produce cosmic rays at will in our laboratories and we shall then know much more than we do now about the ultimate destiny of the universe.

Scientific Problems and Puzzles

(*Continued from page* 59)

strands have been found to be actually stronger than some forms of mild steel. The international critical tables give Chinese silk a rating of 75,000 lbs. per square inch, whereas steel rates all the way from 51,000 to 218,000 lbs. per square inch. Piano wire may actually stand as much as 340,000 lbs. per square inch. Hemp is stronger than silk. It rates about 113,000 lbs. per square inch, and thus is quite comparable with mild steel.

The Differential Hoist

Let X be the pounds of tension in each rope B and C, let F be the tension in rope A. Then, since the total weight supported by these three ropes is 400 lbs., we have the equation $2X + F = 400$.

Now, if we neglect friction, the moments of the forces tending to turn the upper wheel and axle in one direction must equal the moments of the forces tending to turn it in the opposite direction. Hence $5F + 2.5X = 5X$, from which it is evident that $X = 2F$. On substituting 2F for X in the first equation we see that $5F = 400$ or $F = 80$ lbs., the required pull on the rope A.

The Fuelless Motor

THE power required to operate the lamps at the filling station is evidently 40×100 or 4,000 watts or 4 kilowatts. Since each kilowatt is equivalent to 1.34 horsepower a total of 5.36 h.p. must be supplied. Now each horsepower is equal to 33.000 foot-pounds of work per min., hence the cars must furnish not less than $5.36 \times 33{,}000$ or 176,880 foot-pounds per min. If each car weighs 3,000 lbs. on the average and depresses the platform 2 inches or 1/6 of a foot the work done by each car on the system will be 1/6 of 3,000 or 500 foot-pounds. To furnish the required number of foot-pounds then, the cars will have to stop at the station at the rate of 176.880 divided by 500 or 354 cars per minute. A busy station indeed!

A Magnet With Two Similar Poles

A MAGNET may have two similar poles at the ends of the magnet, provided it is properly magnetized. A long, narrow magnet, such as a knitting needle, is easy to magnetize in this manner. All you need to do is to stroke it with a pole of another magnet from the middle toward the end. Then turn the needle around and repeat the process at the other end. Be sure to use the same magnetic pole in the two processes. After the needle has been magnetized it will be found to have the same polarity at the ends, but a pole of opposite and double strength will be found at the middle. Such a needle cannot be used as a compass.

Electrons Passing Through a Lamp Filament

IF it takes 6.3 million million million electrons per second to equal one ampere, it will take one-fifth as many to equal a fifth of an ampere, or 1.26 million million million electrons per second. This is the number that must pass through a 25-watt lamp each second when operated on a 125-volt D.C. line. If one could count these electrons in groups of 10 million each and count two groups each second, it would take 1,930 years to complete the count without taking out time for rest!

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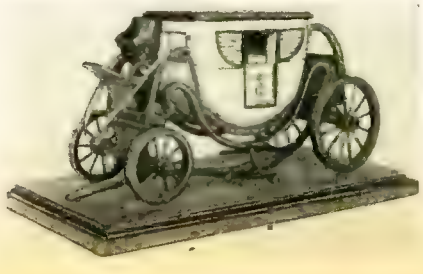

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How to Improve Your Camera

(*Continued from page 50*)

least is required to bring the film into the surface of the field or image.

The curved plates should be wide enough to give the film a runway at both sides, but should not reduce the width of the negative. They may be made of hard-rolled sheet brass, nickel-silver or monel metal, and should be finished with carefully smoothed edges and thinned-down ends. Near each end of the removable back, and directly opposite the short sides of the rear bellows frame, are bars to force forward the film, as shown in Figure 2, and make it follow the curved plates. These may be made of the centre part of steel knitting needles of the right size; they are straight, smooth and hard; and a good way to fix them in is to file or grind chisel edges at the ends, exactly the right length, force the bars into place, and, when you are sure their position is correct, tap the edges of the back at the point shown by the arrow in Fig. 4; the aluminum will flow around the chisel points and hold the bars quite firmly enough.

Notches have to be made in the wooden body of the camera at the points shown in Fig. 3 to admit the bars in the back; in fact, it is better to make the notches before fixing the bars. Care should be taken not to make the notches deep enough to let the bars press the film against the rear bellows frame, as this, of course, would produce scratches; also the bars themselves should not be big enough to keep the back from snapping into place.

Another point is that backs fitted with thin plate springs, intended to keep the film in a plane touching the rollers, must have these springs removed.

After making these changes it probably will be necessary to adjust the focusing scale; usually this is moved easily. It will have to be moved to the rear and set so that the best definition is obtained with a suitable subject 100 feet or more away and the pointer at infinity. The accuracy of the setting should be carefully tested at different parts of the field with a strip of ground glass long enough to rest on the two new curved plates. At the same time it would be well to test the accuracy of the other points on the focusing scale, measuring the distances from the subject in this case, and noting the errors if any, or marking the correct positions for the pointer on the scale.

It occasionally happens that the end of the film will become attached to the protective paper. This may form a wrinkle, and rather than pull it through the narrow space under the bar in the back, at the risk of producing "cinch" marks, it is well to slightly loosen the back when winding off the film.

This description is based on the common form of folding roll-film camera shown in the sketches, but any amateur practised in better things than "pressing the button" can adapt the device to his camera with a little thought and it is well worth while; in some cases the application would be even simpler.

In the important case of the autographic kodaks the bar in the back, at the "autographic" end, may be made to take the place of one side of the shield that depresses the film and protective paper when the record is being made.

While we are discussing the back of the camera we might mention a couple of "kinks" that may be found useful. First, if your films show signs of light leaking in at the back, run a strand of common black wool yarn around the groove into which the edge of the back fits, holding it at a few points with spots of glue. Second, if the end rollers do not move freely, a little graphite, scraped from a soft pencil and worked into the bearing, is better than oil, especially if the bearing is in wood.

Dressing Up the Car for Spring

(*Continued from page 54*)

ing makes it easy to detect loose bolts, missing cotterpins, and the play which generally finds its way into the bearings and parts. It will be easier if you follow some exact procedure in inspecting your car—for example, work from the front to the back, or make a list of the parts to be tuned up and adjusted and check them off as you attend to them. The illustration has been prepared as a guide. It includes practically all of the important parts.

If your car is hard to steer at about 40 miles an hour, it is quite probable the linkages of the steering gear require adjusting. It is possible to set up the ball connections and the worm gear without obtaining the desired results. If a jack is placed under one front wheel of the car and when you rock the tire you find a play in the spindle, the bushings must be renewed.

There are several methods of renewing bushings. Those detailed in our sketch will prove satisfactory. For these methods either a tap which is screwed into the bushing is employed, with a rod to drive it out together with the worn bushing, or a hack saw is used to split the bushing. After the old bushing has been removed it is only necessary to round off the ends of the new bushings. With a long bolt you can jack in two bushings at the same time. As the interchangeable parts usually allow for force fitting, in most instances you will not have to ream out the bushings. And you will notice an improvement in the steering mechanism of your car after their installation.

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The Dance of Death

(*Continued from page 26*)

side, waiting for the victor.

There are quite a few types in which the female does not play a passive part. The male cricket must approach the female with the greatest circumspection, for she is accustomed to throw herself upon anything that moves within her reach. This she invariably devours. That is why he chirps incessantly as he draws near. With the green praying mantis, the male is eaten, at least partly, directly after mating. Spiders must use a good deal of caution; they are served no better. The female spider hurls herself upon everything that enters her net and kills it.

She asks no questions; self preservation is her one objective. Her eyesight is quite poor, and she takes no chances.

The jumping spider (*Attidae*) is an exception to this rule. Nature has endowed all jumping spiders with good eyesight. The sexes can distinguish each other at a distance of ten inches. Even at this distance, when the male performs his dance of love, the female recognizes him. He moves from side to side, first or second pair of legs raised quite high, body weaving first to the right and then to the left. Then he spreads his legs far apart and lifts his back. All kinds of weird positions are assumed in rapid succession, to show off his strikingly colored and uniquely shaped form.

When a pair of *Saitis pulex* lovers meet, the joyous male dances in a semicircle about the female, who watches him closely. He stretches six legs and the palpi of his left side almost parallel to the ground; his two front legs and the palpi of his right side almost touch. Simultaneously he bends as far as he can to one side and still maintain his equilibrium. In this position he dances around the female, a little to her right, a little to her left, again and again. Finally he comes quite close to her. He whirls madly around, faster and faster. As if magnetized, she joins in the dizzy spin.

In the species *Icius*, the male dances his dance of love on six hind legs, while the front legs are elevated over his head, tips touching.

In the majority of cases, the male spider does not depend upon his dancing alone to gain the female. He utilizes the colored or white brushes of hair located on head, palpi or front feet. While dancing, these are displayed to dazzle her. The *Habrocestus splendens* lover has a vividly colored abdomen which he holds in a prominent position. In fact, he halts his dancing several times to raise it high in the air, to make sure his beloved will fall under its spell.

Among all these creatures the love dance is merely a preliminary step in the propagation of the species, When the male dancer is immature, he receives no consideration from the female. She kills him instantly.

Strangely enough, man is one animal who does not dress himself in gaudy array to attract his woman; it is the woman who dons the bright red and oranges, the warm yellows and blues to arouse his interest. It is she who performs for his approval. Here nature's law has truly been turned topsy turvy.

Those Artistic Russian Candlesticks

(*Continued from page 44*)

The following lists of colors will help you paint the candlesticks. Should you have other combinations in mind, we suggest you try them out first, to make sure they will blend harmoniously.

PAINTING CHART

Figure No. 1

	First Choice	Second Choice
Hat	Brown	Brown
Hat Band	Black	Black
Hair	Black	Black
Eyebrows	Brown	Brown
Nose, Mouth and Cheeks	Red	Red
Face and Neck	Pink	Pink
Eyes	Blue	Brown
Collar	White	White
Tie	Red	Black
Shirt	White	White
Vest	Yellow	Red
Coat	Brown	Brown
Trousers	Blue	Green
Standard	Brown	Black
Base	Red	Blue

Figure No. 2

	First Choice	Second Choice
Tub	White	White
Tub Band	Black	Black
Tub Bottom	Black	Black
Hair	Black	Brown
Face and Neck	Pink	Pink
Nose, Mouth and Cheeks	Red	Red
Eyebrows	Black	Brown
Eyes	Brown	Blue
Handkerchief	White (With red flowers and green leaves)	Red (With blue flowers and green leaves)
Dress	Light Blue	Yellow
Arms	White	Light Blue
Apron	Yellow	Light Blue
Legs	White	White
Standard	Black	Brown
Base	Orange	Light Blue

Figure No. 3

	First Choice	Second Choice
Hat	Red	Purple
Hat Band	Black	Black
Hair	Black	Brown
Face and Neck	Pink	Pink
Eyebrows	Black	Brown
Eyes	Black	Blue
Nose, Mouth and Cheeks	Red	Red
Handkerchief	White (Red and green flowers)	Same
Dress with Arms	Green	Red
Hands	Pink	Pink
Apron	Yellow	Yellow
Legs	White	White
Standard	Black	Brown
Base	Brown	Brown

Figure No. 4

	First Choice	Second Choice
Hat	Dark Purple	Light Blue
Hat Band	Black	Black
Hair	Brown	Brown
Face and Neck	Pink	Pink
Eyebrows	Brown	Brown
Eyes	Blue	Blue
Nose, Mouth and Cheeks	Red	Red
Collar and Shirt	White	White
Tie	Red	Blue
Vest	Green	Light Purple
Coat	Light Brown	Green
Legs	Green	Black
Standard	Black	Dark Brown
Base	Light Brown	Green

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Beating the Fly to His Wings

(Continued from page 25)

effective because not a maggot can escape. It has the disadvantage, however, of being rather expensive and laborious where large amounts of manure have to be handled.

Consequently, with the limited application of most of these devices flies continue to breed in the manure, unmolested for the most part, because they cannot be destroyed without endangering crop production, or requiring more labor than the average farmer can afford to expend. Thus the fly has been able to maintain his position in the world as chief carrier of disease germs and the best known pest of all time.

Flies, like all insects that possess what Professor Comstock of Cornell University called "complete metamorphosis," undergo four distinct changes in life. We all know them, of course, in the winged, or adult stage; every farm boy knows that flies lay eggs in the manure of farm animals, or other material where their natural food is abundant, and that these hatch out into maggots (larvae), but few of them know, or realize, that these are flies in the making; but who, of my readers, would recognize the fly in the next stage, the pupa, or can tell where he may be found?

It is now common knowledge that the larvae when fully grown leave the manure pile and go into pupation in the soil, seldom traveling more than 10 or 20 feet before finding a favorable place. By stirring up the soil within this radius the pupae can readily be found imbedded in the soil and usually only an inch or two below the surface. Here is revealed the complete metamorphosis of the fly from the larva to the adult. Larvae active and fresh from the manure pile may be found in the same pocket with larvae that appear distorted to the naked eye, taking on the pupa form; live pupae easily distinguished by their bright reddish-brown oblong casings, each resembling an elongated bead from a lady's necklace; and empty dark-brown, almost black, pupa shells each with a large hole in one end where the winged fly escaped; hundreds of them in each exposed pocket.

The Fly Trap Described

These observations soon made it plain that the most vulnerable period in the life cycle of the fly is during the few minutes that it takes him to travel from the manure pile to the pupation grounds. Here is where we can get him without damaging the precious manure. For the first and only time he is out in the open, a helpless, crawling, wingless creature, fully exposed and defenseless. Here is where he may be trapped in the path that the processes of nature demand that he must go. All that we need now is the trap and that is simple:

Concentrate all the manure into one compact pile. Dig a small trench completely around it, keep it partly filled with an effective larvicide to destroy the larvae as they fall in, and as far as the larvæ is that pile are concerned they are doomed.

After a few preliminary tests in which spent crankcase oil from the garage was found to be an excellent larvicide, the first rick without the soil covering was begun. Immediately, a trench, about 15 inches wide and a foot deep was dug across the far end and along the sides, care being taken that the trench was close enough to the manure pile so that there was no space between them in which the larvae could pupate and thus escape falling into the soil. As each day's hauling of manure was put into place the trench was extended along both sides so that when the rick was finished all that remained to be done was to connect the two ends of the trench across the open end, thus surrounding the whole pile with a moat of oil.

It was observed that during the hot days that followed the larve began falling into the oil within 12 hours after the trench was dug. The oval shows a trench just completed with the surface of the oil already covered with larvae. Another illustration, a close-up view of the trench, affords some idea of the destruction of larvae by this method.

If the smallest space is left between the base of the manure pile and the inner edge of the trench they will find and occupy it to capacity. This was corrected by making the base of the pile and the trench exactly parallel and building the pile so that it hung slightly over the edge of the trench. As an added precaution, a heavy application of powdered borax was used in a strip about a foot wide along the inner edge of the trench just before the manure was laid down. It was also found that, even after the trenches were supplied with oil, spots where the edges had caved in leaving the slide only partly submerged in the oil, they were not long in occupying that too. Another important discovery was, that where the manure ricks are built too wide, larvae hatching out in the center do not have time to reach the ground before pupation overtakes them. This was corrected by building the ricks long and narrow (8 to 10 feet wide at the base).

As to the kind of larvicide to use in the trenches there is wide latitude, availability and cost being the chief determining factors. Plain water is sufficient in certain clay soils. For more porous soils where water will not stand from day to day, spent crankcase oil has been found best because it is deadly to larvae and so far has cost nothing. Even this will be soaked up in some soils and must be replenished every day or oftener. Other materials used with equal effect include mixtures of crude oil, fuel oil, coal tar disinfectant, either separately or together, and diluted with kerosene. Where materials are scarce and water can be used in the trench, much saving of oil can be effected by pouring small quantities on the surface of the water.

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When a Comet Strikes the Earth

(*Continued from page* 11)

shot out from the crater, having arrived in a protecting rock formation, they should have been rough edged and not rounded, as found. This has little weight, however, for the heat of impact might have so rounded them before they were blown away by further explosions. They also had a long history before they ever reached the earth, during which they might have acquired this shape. It does seem strange that not a tiny fragment of this rock survived, however. The only suspected fragment was found at some distance and is generally believed to have fallen at some later time.

The fact remains that we cannot, as yet, say exactly what the nature of this meteor was; nor can we say what velocity it had when it struck the earth.

The Meteor Crater has often been likened to the craters which are everywhere to be seen on the surface of the moon, some of which are as much as five hundred miles across and ten miles deep. Much speculation has existed as to the possible origin of these. There is as yet no suggestion that seems more reasonable than that these, too, were formed by meteor bombardment, perhaps at a time when the moon was hot enough to have been somewhat plastic. Craters almost exactly resembling those of the moon can be formed by dropping stones in soft mud. A comparatively small stone will make a very large crater, if given sufficient velocity.

A corkscrew meteor trail. Atmospheric resistance upon the irregular surface of the meteor causes it to follow this path.

We are quite sure that the Meteor Crater is actually due to a meteor. Is one likely to strike the earth again? Is it possible that such a meteor might flatten one of our large cities tomorrow? The answer to this question, disturbing though it is, must be in the affirmative. Let me quote from a news item in the New York *Times* of last January. "The huge red ball, with a shower of 'sparks' in its train was flattened at the rear and seemed half the size of the moon as it reached its zenith." Its yellow and red tail was described as being approximately twenty times the diameter of the ball. And further in the same dispatch, "Increasing in brilliancy as it reached the eastern horizon, the meteor illuminated the darkened sky and, against its radiance, the white dots of stars paled and faded altogether from the heavens. Startled Manhattanites breathed easier when the fiery sphere sped on beyond their view below the artificial horizon of skyscrapers."

There would be no reason for great surprise if a meteor even larger than that which struck in Arizona years ago should strike tomorrow, or even in the next hour after you read this. It is one of the chances we must take.

Geologists estimate that the earth encounters from ten to twenty million meteors every day, and that as many as

Photograph of a bright meteor. The rotation of the earth during the exposure of the plate coused the stars to leove curved troils.

a trillion strike the sun every second. Most of these are of negligible dimensions, mere dust specks which burn up almost as soon as they strike our atmosphere. Meteors of sufficient size to give the appearance of falling stars can be seen in the sky any evening at the rate of seven or eight per hour. One must be away from city light to count this number. On the average, there are perhaps as many as a hundred every year of sufficient size to reach the earth without having been consumed by air friction. They may weigh anywhere from a few pounds to as much as seventy tons. The largest meteor ever discovered, located in Southwest Africa, has been estimated to weigh that much.

There is, thus, no reason to believe that we are immune from possible bombardment by large meteors which might strike in a much more vulnerable spot than Africa. It would be an interesting though disastrous experience.

If another "Barringer Meteor" should fall I wish you the good luck to be near enough to see it—the greatest spectacle ever witnessed by man—but at the same time I wish you to be far enough away so that you will neither be struck by flying missiles, nor have the cells of your body disrupted by the super-sonic vibrations which were apparently powerful enough, in the Arizona case, to shatter grains of sand.

IN THE NEXT ISSUE

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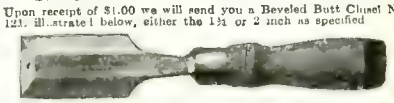

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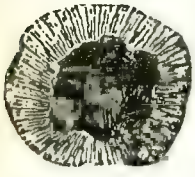
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Watching the Earth Rotate

(*Continued from page 24*)

to support it so that the needle pointer just clears the floor. In order to eliminate the torsion in the wire, the pendulum should be allowed to hang free for a period of about twelve hours. Next, mark out on the floor a circle the centre of which is directly under the pointer of the pendulum, and mark out the angles through which the pendulum will move every hour, half hour, or quarter hour, according to the latitude of the place. Or the floor directly under the pendulum may be sprinkled with an even layer of sand just deep enough so that the pointer of the pendulum scrapes through it as it swings.

The pendulum may now be drawn to one side a few feet, ready to swing. In order to insure a perfect start, free from lateral oscillation or vibration, a loop of string should be placed loosely around the middle of the cannon ball and tied to a fixed point. The pendulum should then be left undisturbed for at least an hour, so that all vibrations may die down. The pendulum is then released by burning through the string by means of a lighted match, this method ensuring a perfect start, free from any oscillatory jolt. As the pendulum commences its swing, it will trace a line in the sand, or follow a marked line on the floor (whichever method is used). As time goes on it will be seen that the plane of oscillation of the pendulum gradually turns, as indicated by the traces in the sand, or by the fact that the pointer tends to follow the next marked line on the floor.

Science and Invention's Foucault pendulum experiment in full swing.

The principle of the experiment can very easily be demonstrated by anybody with very little trouble, by means of the simple apparatus shown in Fig. 4. A round, wooden platform, six or eight inches in diameter, is mounted on a vertical shaft, and a metal pendulum bob is suspended by a fine thread from the centre of the arch. After setting the pendulum swinging, the entire apparatus may be slowly rotated several times on the vertical shaft before the torsion of the thread causes the plane of oscillation of the pendulum to change.

In discussing the Foucault pendulum with Ye Editor recently, he recalled that somebody, a long time ago, suggested to him that if a human being were to take the place of the cannon ball, it might be possible for that person himself actually to *see* the earth rotate, or swing past him. After considerable discussion it was decided that Ye Editorial Staffe should hie them forth and perform the experiment, just to see what could be made of it.

Our first problem was to find a suitable building with a high enough roof, and obtain permission to use it. Eventually, through the courtesy of Col. Wm. J. Costigan, the armory of the 165th Infantry Regiment (the old 69th) was placed at our disposal. A rigger scaled the girders and attached the suspension wire to the centre of one of the roof girders, 115 feet above the floor.

To the lower end of the wire we attached a wooden platform upon which the observer was to sit. This was weighted and left all night to eliminate all torsion from the wire. Next morning we resumed our experiments, but with disappointing results. The human pendulum invariably commenced to follow a gradually expanding elliptical path, the longer axis of which gradually turned in an anti-clockwise direction, instead of in a clockwise direction, as it should. Two causes were responsible for these failures. In the first place, the resistance offered to the air in swinging was not so evenly distributed in the case of a human pendulum as it is in the case of a cannon ball. Secondly, the process used in preparing a cannon ball for the experiment insures that the centre of gravity shall be properly located. In the case of a human pendulum it is practically impossible to arrange the subject on the suspended platform so that his weight is evenly distributed.

When a heavy weight was placed on the platform instead of the human being, we began to obtain indications of better results, but it was clear that unless we were prepared to go the limit in preparing the experiment properly, we would not get perfect results.

It would be interesting to place a movie camera within a hollow cannon projectile, or shell, to locate the vertical axis passing through its centre of gravity properly by floating the combination on mercury, and arrange for the shutter to operate automatically at the end of each swing of the pendulum, so as to make one exposure per swing. When projected at normal speed, such a film should show what we attempted to see personally—the walls of the room gradually swinging past from right to left.

—A. D.

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Man—A Tool-Using Animal

(*Continued from page 29*)

begins to change is about 250 degrees Fahrenheit. Therefore the surface remains uncolored and gives no warning to the grinder. Tempered tools must be kept cool, and that is principally the reason for the use of *wet* wheels for grinding their edges.

Again the cutting angles of tools have been carefully determined by the makers, and if changed, as might occur at regrinding, the efficiency of the tool is reduced. An angle gage is not costly and is quite easy to use. Some men grind a screw-driver with a tapered end, which gives two results—the spoiling of the shape of the screw slot and the weakening of the driver's grip there. For the harder the pressure on the screw-driver the easier it slips back out of the slot. If a twist drill is reground with its point out of center, the hole it makes will be larger than the drill. A close-fitting set wrench will not cut the corners of and spoil a hexagon nut, but a monkey wrench may do so and also overstrain its own feed screw. A buckled hand saw is a nuisance. Files often are worn dull more by dragging on the back stroke than when cutting forward. Reversing the direction of rotation of an auger bit or a metal reamer when removing it from a hole is not good for the tool.

Again while most tools are made of old-fashioned high *carbon* tool steel, some of more recent design are of high *speed* tool steel. They are not interchangeable in their application to shop work. The high *carbon* tools cut best at moderate speeds; the high *speed* tools at speeds about five times faster and they do not work efficiently at the slower cutting speeds of the high carbon tools. For the maintenance of a cutting edge high carbon tools depend on the iron carbide in the steel, which is produced by the hardening and tempering of the tool. It gives a *hard*, fine-grained edge suited to wood-working chisels, planes, bits, and for the keenest edged tools like razors and lancets.

The cutting edges of high-speed tools, like twist drills, hack saws, inserted-tooth circular saws, are not quite so *hard* as those of high carbon tools, but much *tougher* and more durable under heavy pressure and high cutting speed conditions, and while the high carbon tool must not be overheated, the high-speed steel tool will maintain a good cutting edge at even a red heat, about 800 degrees Fahrenheit. These remarkable characteristics are produced by alloys in the steel, such as tungsten, chromium, vanadium. The simple rule is to use high carbon tools for *slow* speed and high speed steel tools for the *fastest* speeds. The first would be found in the penknife blades cutting wood from 20 to 50 feet per minute; the last in, say, the teeth of a modern circular saw revolving at a speed of from 5,000 to 10,000 feet per minute at their cutting edges.

Answers and Prize Awards in February Puzzle Contest

First prize, of $10, is awarded to:

Walter Smolck, South Mountain, Franklin Co., Pa.

Second Prize, of $5, is awarded to:

Hamilton Talbott, 1426 Crittenden Street, N. W., Washington, D. C.

The ten prizes, of one dollar each, are awarded to the following:

Mrs. Homer G. Stroud, 910 West Monroe Street, Jonesboro, Ark.

Samuel A. Sloan, 745 Chislett Street, E. E. Pittsburgh, Pennsylvania.

Frank Hayne, 301 Washington Street, Freeland, Pennsylvania.

B. Forrest Voeks, 6223 12th Street, N. E., Seattle, Washington.

Lester J. Schroll, Aledo, Illinois.

L. G. Cabrera, R. F. D. No. 1, Box 275, El Paso, Texas.

Stewart Huey, 100 Ridgefield Avenue, Waterbury, Connecticut.

Herman Howe, Box T, Leavenworth, Washington.

Edwin R. Shaw, 506 Lyon Street, N. E., Grand Rapids, Michigan.

Mrs. Guy R. Porter, 1502 Laurel Avenue, Minneapolis, Minnesota.

Solution to "Sheep and Goats"

THE odd and even numbers are put into separate groups, with a central vacant circle, by the following twenty-two moves and jumps:

9 moves, 4 jumps, 1 moves, 10 moves, 2 jumps, 5 moves, 16 jumps, 14 moves, 5 jumps, 8 moves, 7 moves, 1 jumps, 3 moves, 16 jumps, 9 jumps, 2 moves, 8 jumps, 9 moves, 14 jumps, 1 moves, 3 jumps and 14 moves.

Solution to "Poultry Posers"

SINCE 1¼ hens could lay a quarter's worth of eggs in a day and a quarter, one hen in one day could lay 16 cents worth of eggs, and ten hens could lay $3.20 worth of eggs in two days.

The young couple who started their poultry farm with a mixed flock of 25 chickens and geese, must have had 20 geese and 5 chickens, and later had 120 geese and 80 chickens.

Let X represent the number of chickens at the start. And 25 minus X will equal the number of geese.

Let Y represent the geese rate of increase; and 3Y will represent the chicken rate of increase. The increase in mixed fowl was 175.

Therefore—3YX plus 25Y minus XY equals 175.

Reduced—Y (2X plus 25) equals 175.

X being a whole number, and less than 25, can have no value other than 5.

Solving, we find Y equals 5.

The 5 chickens increased 1500% to 80.

The 20 geese increased 500% to 120.

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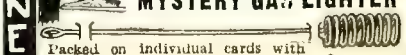

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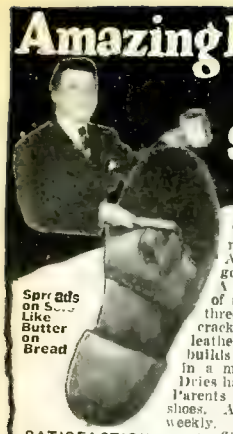

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Winners of Ideal Home Workshop Contest

(*Continued from page 28*)

so I have omitted it from the list. The mechanical equipment was selected because the modern times call for machines, saving considerable time in production, as well as producing finer work. The workbench I have planned on is 4′ × 8′ in size, and the line-shaft and belts will be correct as to length. I believe a line-shaft is preferable to separate motors, because when belts of machines not in use are slipped off the pulley, all the motor's power goes into the one machine in use, besides allowing more machines to be added later.

The saw was selected because of its ruggedness, capacity, and usefulness over all others,—the jointer mainly because of its tilting fence of 90° *both* ways, making beveling with the grain much easier. The jig saw was selected because of stronger construction and adjustable tension of blade, which can also be set at any angle with additional equipment. The lathe was chosen because of heavier head stock, ball bearing tailstock, greater range of speeds. It can be used for routing, boring and sanding. The bandsaw I considered a masterpiece. It has a strong frame, perfect guides and guards, and large table and capacity. Guards were included for saw and jointer for safety, but I think the band saw is sufficiently protected.

The 8" combination saw would be used for rough cutting and the mitre saw for fine cabinet work. The balance of the attachments make the selection complete.

Saws, planes, chisels, hammer, and augers with brace I consider the very necessary items in any shop. I have chosen the best. The brace will take augers, straight and taper shank drills, up to ½" diameter shank. Twist drills are high speed steel and can also be used in lathe chuck. I have used or seen every tool listed except the clamps and hand screws. I have omitted wooden mallet because it can be turned on lathe. Extra handles for tools can also be turned, using tubing for ferrules.

May I thank you for the opportunity of entering this contest. Every man likes good tools and will read the magazine that features them. With best wishes for the continued success of SCIENCE AND INVENTION.

Mr. Coll's List of Tools:

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Saw guard and splitter	4.50
Endless belt, 1½" × 45"	1.00
3" Diameter pulley, crown 1¾", bore ¾", setscrew	1.50
4-INCH BALL BEARING JOINTER,	
includes 3 knives	25.00
Safety guard	2.50
Endless belt, 1½" x 45"	1.00
4" Diameter pulley, crown 1¾", bore ¾", setscrew	1.75
10-INCH JIG SAW,	
includes one blade	12.00
Endless belt, 1¼" x 48"	1.25
1½" Diameter pulley, crown 1¾", bore ¾", setscrew	1.25
4-SPEED LATHE, 36" CENTER TO CENTER,	
includes drive and cup centers, 3" face plate tail stock, 3" and 6" tool support base and 2 wrenches	24.45
V belt, 23¾" center to center	1.25
4-Speed pulley, ¾" bore, setscrew	1.50
12-INCH BAND SAW,	
includes one blade	37.50
V belt, 24" center to center	1.40
2¾" pulley, ¾" bore, setscrew	.60
Four self-aligning hangers, mill type, $2.25 each	9.00
Eight feet ¾" line shafting, 25c per foot	2.00
One shaft collar, for ¾" shaft	.40
One flexible coupling, ¾" bore on both sides	1.80
REPULSION INDUCTION MOTOR,	
½ H.P. 110/220 volts, 1 phase, 60 cycles, A.C., 1750-1800 R.P.M. with ¾" shaft, type SCR	28.00

SAWS

8" Combination rip and cross-cut saw, ¾" hole	$ 3.75
8" Hollow ground mitre saw, ¾" hole, 15-18-15 gauge, style #37	4.28
5" Dado head, ¾" hole, cuts grooves ⅛ to 13/16"	12.00
Arbor for emery wheels, takes ¾" face and ¾" hole wheels	1.50
Carborundum wheel, 4" diameter, ¾" face, ¾" hole, fine grain	1.20
Emery wheel dresser, wheel type	1.10
8" Diameter buffing wheel, ¾" hole, two ¼" sections at 40c each	.80
6" Wire scratch brush, ¾" hole, two ¼" sections at 75c each	1.50
Mitre guide, fits saw and lathe boring table.	2.25

LATHE

Drill chuck, ½" capacity, fits any ½" shaft	2.50
⅜" Router bit, ½" shank	1.90
½" Router bit, ½" shank	1.90
Combination boring, routing and sanding table	5.00
Sanding drum, 2" face, 2½" diameter	2.00
Disk sander, 8½" diameter	2.50
Garnet paper disks, 8½" diameter, per doz.	1.00
Turning gouges, ¼" at 60c, ½" at 73c, ¾" at 90c	1.23
Turning chisels, ¼" at 43c, ½" at 50c, ¾" at 62c	1.55
Square chisel, ½" at 57c, right skew chisel, ¼" at 57c, round chisel, ½" at 57c, left skew chisel, ½" at 57c, diamond chisel, ½" at 75c, parting tool, ⅝"	3.65
8½" Handles for above tools, 4 handles at 30c each	1.20

JIG SAW

Mixed jig and fret blades, per dozen	1.65

Hand Tools

SAWS

26" Cut-off saw, 9 points per inch, straight back, ship point	$ 6.00
26" Rip saw, 5½ points per inch, straight back, ship point	6.00
12" Back saw, 14 points per inch	2.75
Nest of saws, 10" keyhole, 14" compass, 16" nail cutting	2.50
Hack-saw frame, adjustable to 8" to 10", with one blade	1.00
Saw clamp, #2	1.95
Saw set, #5	2.25
Saw jointer, #15	.25
7" Slim taper file, for rip saw	.25
7" Extra slim taper file for cut-off and back saws	.30
Ferruled handles, two of #3 at 10c each	.20

PLANES

Adjustable smooth plane, 9" long, 2" cutter	4.65
Adjustable jack plane, 14" long, 2" cutter	5.35
Block plane, adjustable throat, 1⅝" cutter at 12° angle, 7" long	2.50
7½" router plane, ¼" and ½" and smoothing cutters, depth gauge	3.90

CHISELS

Beveled firmer chisels, 5½" long to bolster	
⅛" ¼" ½" ¾" 1"	
.74 .74 .83 .91 1.05	
These chisels are ground but not honed..	4.27
Firmer gouges, outside ground not honed	
¼" ½" ¾" 1"	
.57 .63 .73 .87	2.80
Beveled butt chisels, 2½" blade	
⅛" ¼" ⅜" ½" ⅝" ¾" ⅞" 1" 1¼" 1½"	
.74 .74 .78 .83 .88 .91 .93 1.05 1 37 1.54	9.82
These chisels are ground, not honed	

BRACES, DRILLS AND BITS

Concealed ratchet brace, 10" sweep metal-clad ball-bearing head. The jaws will also hold straight and tapered shanks	$6 15
Parallel frame hand drill double pinions, ¼" capacity	3.70
Automatic drill, with eight drills 1/16" to 11/64"	2.60
Adjustable gauge for auger bits, 2½" long	.90
Auger bits, double lip	
⅛" ¼" 5/16" ⅜" ½" ⅝" ¾" ⅞" 1"	
.60 .50 .50 .50 .50 .60 .70 .85 1.00	5.75

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Twist drills, for wood, high-speed steel 1/8" 1/4" 5/16" 3/8" 1/2" .45 .60 .70 .80 1.05	3.60
These drills can be used in chuck in lathe	
Expansive drill, with two cutters, 7/8" to 1¾" and 1¾" to 3"	2.00
Nail hammer, adze eye, drop forged	2.00
Riveting hammer, cross pein, 0 size, 11" overall, 4 ounce	1.10
Metallic plumb and level, adjustable, 12" long	2.65
Extension zig-zag rule, four foot	.70
Steel square, blued, body 18" x 1½", tongue 12" x 1"	2.80
Two-foot, four-fold, full-bound rule, square joints, caliper	1.80
Metal bar gauge, two pin points and two roller cutters	1.60
Scraper handle and blade, 13" long, 3" blade	1.45
Scraper burnisher, 8" overall, 3½" blade	.70
Hand cold chisels, one each, 7/16" bit 45c, ¾" bit 60c.	1.05
Nail sets, one each, 1/16" and 1/8" at 20c each	.40
Center punch, 1/8" tip, 4" long	.20
Scratch awl, blade 2¾" long, 7/32" diamerer, 5⅞" overall	.35
Brad awl, 1" blade, point diameter 1/16", overall 4¾"	.35
Screwdriver, 3" blade, 7/32" diameter, 8" overall	.35
Screwdriver, 6" blade, 5/16" diameter, 11¾" overall	.60

HAND TOOLS

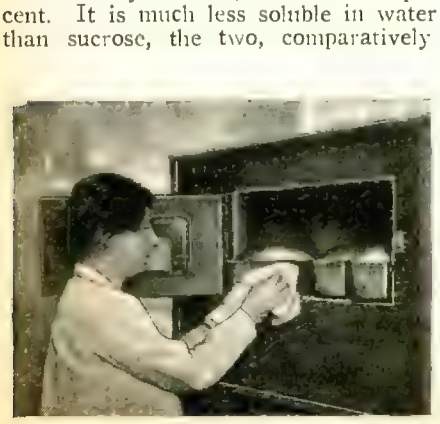
Adjustable spokeshave, 10" long, raised handle, 2⅛" cutter	$ .75
Rose type countersink, ¾" cutter, 4¼" long	.45
Screwdriver bits, for brace, one each ¼" and ⅜" bit for 25c each	.50
Household axe, 2¼ pounds	1.75
Household putty knife	.35
Household pipe wrench, 1/8" to 1" capacity	1.25
Combination set, square, center, and protractor head, 9" blade	6.00
Dividers, 8" long, pencil can be used in leg	1.65
Firm joint outside calipers, 8" long	1 00
Forged steel tinners' snips, 2½" cut, 11½" long, cuts curves easily	2.63
Single end wrench, 12" long, 1 5/16" capacity	1.75
Slip joint thin nose pliers, 8" long, 1¼" capacity	.75
Long nose side-cutting pliers, 6" long	1.30
End cutting nippers, 6" long	1.00
Glue pot, copper inside pot, three heats, asbestos cord and plug	7.25
Glue brush, ¾" diameter	.75
Steel bar clamps, 36" capacity, two at $1.95 each	3.90
Malleable iron carriage clamps, open 6", two at 75c each	1.50
Malleable iron carriage clamps, open 10", two at $1.50 each	3.00
Adjustable spindle hand screws, 10" maple jaws, open 6½", two at $1 10 each	2.20
Woodworkers' vice, jaws 4"×7", opens 9"	8.00
Swivel base, anvil-back vise with pipe jaws, jaws 3" wide, opens 3½"	3.00
Glass cutter, 4¾" long, three-keyed glass breakers	.15
Electric soldering iron, 110 volts A. C. current	2.00
Sandpaper, one quire (24 sheets) of each, Fine, 20c; coarse, 26c	.46
10" Mill bastard file, second cut, with one round edge	.35
10" Half-round file, second cut, double cut	.45
10" Round file, second cut	.35
8" Cabinet rasp, smooth cut	.55
File card, with scorer	.50
Ferruled handles, one of #3 at 10c, three of #2 at 15c each	.60
Slipstone, 2" x 4" x 3/8" to 1/8"	.70
Sharpening stone, fine on one side, coarse on the other, 7" x 2" x 1"	1.50
Oilstone, medium, 6" x 2" x 1"	1.10
Oil, 1 ounce can, to lubricate sharpening stone, oilstone, and to rub on tools to prevent rust	.15
Total	$399.99

Lifting the Ban on Corn Sugar

(*Continued from page* 17)

liquor is now ready for concentration. For this treatment it goes to multiple effect evaporators. After this has been accomplished the semi-syrup is clarified and decolorized by filtration through bone char, coming out a brilliant and water white. Crystallization is now induced by working into the mass crystals of corn sugar. Cooling follows by running the liquor into tanks surrounded by copper coils through which water is circulated. The whole is now "seeded" by stirring into it more crystals of corn sugar. The heavy syrup is now run into molds where it is permitted to solidify. The result is corn sugar.

Corn sugar, or dextrose hydrate, as it is known in the chemical laboratory, is about 68 per cent as sweet by weight as sucrose. By volume it is about 54 per cent. It is much less soluble in water than sucrose, the two, comparatively



Corn sugar is also used in the bakery.

standing, 81.68 parts of corn sugar by weight in 100 parts of water at 17 degrees C. and 198 parts of sucrose to 100 parts of water at 20 degrees.

Corn sugar has a low carmelizing point, that is, a "browning point," something much desired in such breakfast delicacies as pancakes, doughnuts and waffles. Bakers find it very satisfactory as a yeast nutrient in a bread sponge. Its lack of excessive sweetness makes it popular with fruit packers in the retention of delicate fruit flavors.

Corn sugar is of inestimable value in child feeding and the earlier stages of Bright's disase. It is credited with being the only sugar at present commercially available for the treatment of this disease which does not aggravate it.

It is used in the manufacture of commercial pectin and in the fermentation of wine and vinegar. In these two juices it causes maximum fermentation without producing undesirable secondary flavors. It is used as a crystallizing agent with cane sugar in the manufacture of the fancier types of candy.

New uses for corn sugar are expected to be found in connection with the manufacture of sweetened condensed milk and sweetened condensed skimmed milk, almond paste, pickles, sweet pickles, catsup, sweet chocolate, sweet chocolate coating, milk chocolate, sweet cocoa, sweetened cocoa, ginger ale, sarsaparilla; in the putting up of cold packed fruit, canned fruit, preserves, fruit preserves, jam, fruit jam, fruit butter, jelly, fruit jelly, citrus fruit, marmalade, canned vegetables, canned peas.

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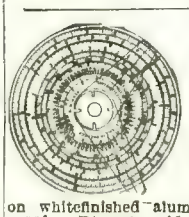

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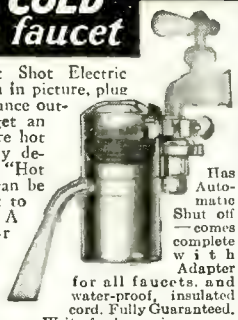

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IN MAY "RADIO NEWS"

Those who are at all interested in things scientific and particularly in any phase of radio will find a full measure of enjoyment and worthwhile information in the May issue of RADIO NEWS. For those who like to delve in basic things, for instance, there is an article by Dr. E. E. Free, widely known scientist, on "Solar Systems and Radio" in which he discusses the possibility of variations in radio conditions being the result of solar influences.

A very interesting and instructive article by Albert Pfaltz takes the reader "backstage" during the production of radio dramas and provides an insight into the problems of such productions which cannot help but be of vital interest to the ever growing thousands of radio drama fans. Then there is an article, "Ganging Black Light", which shows how radio circuits are used in measuring ultra-violet radiation, as in determining the curative power of health lamps, the proper degree of radiation for industrial processes and so on. John Rider, in his article, "Radio—Then and Now," traces the evolution of radio receiving equipment from the earliest vacuum tube receiver of 1913 to the modern radio of today.

In an article on "The Boston Television Party" Joseph Calcaterra discusses practical television developments to date and presents a list of the stations which are putting television programs on the air regularly. There is also a description of a portable short wave radio telephone transmitter and receiver that weighs only nine pounds and operates on batteries to provide a communication range of fifty miles or more.

In addition to all these there are numerous other articles on every phase of radio and allied sciences, not overlooking the several regular monthly departments, such as "The Home Laboratory"; "In the Radio News Laboratory"; "What's New in Radio" in which are presented descriptions of new radio products; "Backstage in Broadcasting", a chatty studio news column by Samuel Kaufman; "The Junior Radio Guild", a department for the radio engineers of tomorrow and now presenting a complete course in mathematics which started with simple arithmetic and is continuing on to higher mathematics.

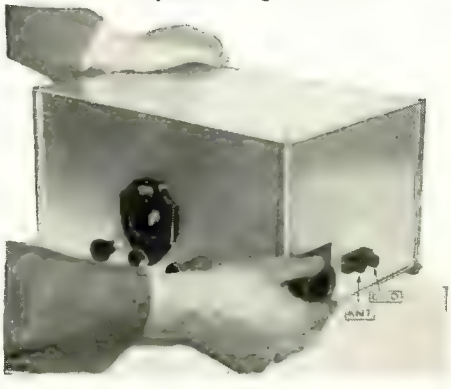
The May issue is but typical of the type and variety of material that has made RADIO NEWS the outstanding publication in the radio field today.

The S. and I. Globe Trotter

(*Continued from page 56*)

been made, for while the hum is very low it naturally is entirely too much for use with phones.

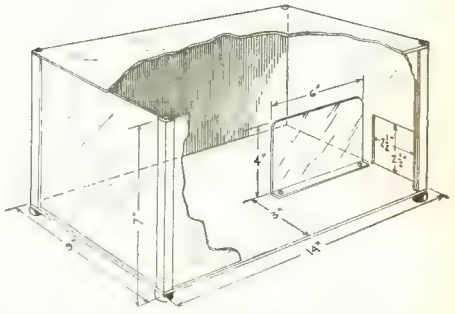
The power supply consists of power transformer, Pt., dual choke, Ch, Mershon Electrolytic condenser and voltage divider R6. Upon examination, the primary of the power transformer will be found to have a cord for attaching to the a. c. lines. If it is desired to use a switch in the primary circuit it may be inserted by cutting one of the twisted pair and connecting the switch, which may be of any convenient type. Four secondaries furnish the various voltages to supply the receiver. The upper two binding posts (1 and 2) on the panel of the transformer will furnish the necessary current to light the filaments of the R.F., detector, and first audio tubes. This secondary is not center tapped, nor is such a tap necessary. Grounding one side of this secondary will suffice. The next two binding posts (3 and 4) are used to supply the filament of the power tube. This secondary is not center tapped either, hence the necessity of the use of R7 to furnish an electrical center tap. The third secondary (binding posts 5 and 6) is to light the rectifier tube. A connection is also made from one side of this secondary to binding post number 1 on the combination choke Ch. The lowest set of binding posts (7, 8 and 9) on the transformer is the high voltage secondary. The two outside connections go to the plates of the rectifier tube, while the center tap, being the negative of the entire system, is grounded.



Showing how the tuning coils are inserted at the side of the cabinet.

The combination choke, Ch. is in reality two chokes in one housing, which are wired into the circuit exactly as though they were two. The connection to binding post number one has been covered in the previous paragraph. Binding post number 2 should be connected to one of the 18 mfd. sections of the electrolytic condenser, and also to one of the output (speaker) binding posts on the left-hand end of the receiver. Binding post number 3 should be connected to the remaining 18 mfd. section of the condenser, and also to the voltage divider resistance R6. This connection is also the B plus supply for the R.F. tube, and a wire should be run from this point to the filament prong on the coil socket and also to the B plus connection on the second audio transformer (T2), thus furnishing potential for the first stage of audio frequency amplification.

Two sliding taps are used on the voltage divider resistance. These in turn furnish potential to the screen grid of the radio frequency tube, and plate potential to the detector tube. These taps are bypassed by connecting each of them to the two 8 mfd. sections of the condenser. How to set these taps in their proper position will be explained later. The other end of this resistance should be grounded to a convenient point on the base board.



Dimensions of the S. and I. Globe Trotter cabinet.

It will be noticed that all the various components are mounted on the base board with the exception of the dial, the volume control, the regeneration control, the voltage divider resistance, the input antenna and ground posts and output binding posts. Convenience suggested mounting these various parts on the sides and ends of the cabinet, with the exception of the voltage divider resistance. A certain amount of heat is liberated by this resistor, and mounting it high gives the heat a chance to dissipate itself without harm to other components. All of these parts are wired into the circuit after the cabinet is assembled, loose ends of wire being left in place until assembly, which are then cut to length and soldered, with the exception of the two variable resistances on the front panel. These should be completely wired into the circuit, left loose until the front panel is in place, and then mounted. Incidentally, the antenna potentiometer must be insulated from the panel by the washers furnished.

In the wiring of the receiver, the constructor is advised to use Leo Neiman special hook-up wire, which is solid No. 18 wire with an insulation which contains a high percentage of para rubber so that it strips easily. Also the wire is tinned so that a good clean soldered joint is assured. After the assembly and wiring is completed, and a thorough check has shown the wiring to be according to the diagram, connect antenna and ground and loud speaker. Insert the tubes and line cord. At first, nothing will be heard. The electrolytic condenser must be given a chance to "form." After about

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fifteen minutes the receiver will be ready to operate, although it may take as long as two hours before the hum has gone down to normal. (It is of course assumed that one of the coils is in place before the receiver is turned on.) Set the taps on the voltage divider resistance to 90 volts and 45 volts respectively, using a voltmeter connected between the tap and ground.

"Octo" coils are recommended for use in the "Globe Trotter," although any other plug-in coils of like characteristics may be substituted. The Octo coils cover a range from 16 to 225 meters in four steps, and the coils are of different colors for easy identification. The green coil covers the range from 16 to 30 meters, the brown from 29 to 58, the blue from 54 to 110, and the red from 103 to 225 meters.

On the green coil, at about 0 on the dial, one should be able to get W9XAA, Chicago on 16.57 meters, although they broadcast irregularly in the daytime. At about 10 on the dial, you will find W8XK, Pittsburgh, 19.72 meters, on Wednesday and Saturday mornings. Just above this will be heard the amateur 'phones, between 20.97 and 21.26 meters. About 60 on the dial will bring in W8XK, using their 25.25 meter wave from 12 noon to 10 p.m. daily, E. S. T.

The brown coil will probably cover more of the broadcasting stations than any of the other coils, with W2XAF, Schenectady, 31.48 meters, audible in every part of the United States. They will be found at about 60 on the dial.

The blue coil covers most of the ship to shore 'phone, as well as the amateurs on 84.46 to 85.66 meters, while the red coil extends into the lower reaches of the broadcast band.

With so much on the air below 200 meters, you will find that there is never a moment in the day when some station can not be found on the dials of the "Globe Trotter," perhaps in some of the remote places of the globe that one sometimes reads of and can never pronounce. A new thrill awaits the experimenter who, for the first time, tunes to the lower wave bands.

Now for a little word of warning. Don't expect to tune in China after operating the receiver for ten minutes, because you won't. An almost infinite patience is required to get the most from a short wave receiver, and you will find that as you begin to learn the "feel" of your receiver, more and more stations will be logged. You will also be surprised how clearly you can hear the Europeans after you have mastered the art of tuning properly.

List of Principal Foreign Short-Wave Stations Which May Be Heard on the S. and I. Globe Trotter

Wavelength Metres	Station	E. S. T.
16.57	W9XAA, Chicago, Ill.	Daytime, irregular
19.72	W8XK, Pittsburgh, Pa.	Wednesday & Saturday, 7-11 a.m.
20.95	G2NM, Sonning-on-Thames, England	1.30-3 p.m., Sundays
25.25	W8XK, Pittsburgh, Pa.	12 noon-10 p.m., daily
25.30	KA1XR, Manila, P. I.	1 a.m.-9 a.m., irregular
25.34	W9XAA, Chicago, Ill.	7-8 a.m., 1-2, 4-5, 6-7.30 p.m.
25.40	2RO, Rome, Italy	Irregular, 11 a.m., 1 p.m., 2.30-5 p.m.
25.53	G5SW, Chelmsford, England	Monday to Friday, 7.30-8.30 a.m., 2-7 p. m.
25.65	KIO, Kauhuku, Oahu	Irregular, 2 p.m. to 8 p.m.
28.98	LSX, Buenos Aires	7-9 p.m.
29.50	HS2PJ, Bangkok, Siam	Monday, 8-11 a.m.
30.50	TIH, Heredia, Costa Rica	10-11 p.m., daily
30.57	LSOR, Buenos Aires	6-9 p.m.
31.30	PCJ, Eindhoven, Holland	Thursday, 1-3, 6-10 p.m., Friday, 1-3 and 7-12 p.m.
31.30	KA1XR, Manila, P. I.	Irregular, 1-9 a.m.
31.35	W1XAZ, Springfield, Mass.	7.30 a.m.-11 p.m.
31.38	Zeesen, Germany	3-6.30 p.m., irregular
31.48	W2XAF, Schenectady, N. Y.	5.30-11 p.m.
31.55	WK3ME, Melbourne, Australia	Saturday, 3-6.30 a.m.
32.00	VK3UZ, Melbourne, Australia	Sunday, Tuesday & Friday 3-7 a. m.
36.92	PLW, Bandoeng, Java	Friday, 3-7 a.m., also irregular
37.50	J1AA, Kemikawa, Japan	5-11 a.m.
39.40	HKF, Bogota, Colombia	9-11 p.m.
39.80	El Prado, Riobamba, Ecuador	Thursday, 9-11 p.m.
40.70	XEP, Nueva Laredo, Mexico	Irregular
41.70	HKF, Bogota, Colombia	9.30-11 p.m.
42.00	PT1AA, Lisbon, Portugal	Friday, 5-7 p.m.
42.00	HKX, Bogota, Colombia	9-11 p.m.
42.90	HKD, Barranquilla, Columbia	Mon., Wed. and Fri. 9-11 p.m.
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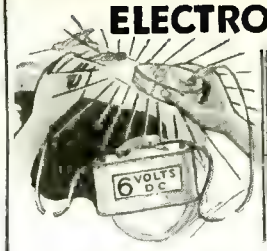

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Winners of Ideal Home Workshop Contest

(*Continued from page 28*)

tool can be driven direct from the motor. It cannot be surpassed for light home-shop work. Nor can any set of tools duplicating its uses be substituted at its cost.

The lathe is capable of running 100 continuous hours; it has a four step head stock pulley, capable of developing 750, 1250, 1750 and 2250 R.P.M's respectively. The lathe will turn work nine inches in diameter and 36 inches long, having a total base of 46 inches.

The scroll saw I selected has a 12-inch frame with a 5¾ × 5¾ inch steel table, *V* grooved pulley has also been selected. The flexible shaft I want is a most useful tool, not only in the shop but in the garage and home.

A work bench is incomplete without one. These four power-driven tools make a very complete and compact woodworking outfit, covering an area of only 68 × 80 inches. The small tools I selected are nationally known for their quality, and one can readily understand why the best dealers carry them.

All the tools on my list have been selected with the greatest care. I have taken into consideration the quality and durability one might expect. The majority of them I have used in making things for myself. The list contains over 136 tools.

Mr. Beall's List of Tools:

Power-Driven Tools

1 Woodworker combination, 20" x 24"....	$45.00
1 Lathe, 3" face drive and cup centers, tail-stock base 44", ½ shaft, 3" x 6" tool support, capacity 9" diameter, 36" length	24.45
1 Head stock for lathe, 4-step pulley, ½ shaft	8.75
1 V-Belt, 22¾" long, for lathe	1.25
1 Scroll saw, 12" frame, 5¾" x 5¾" steel table, 7¼" V-grooved pulley, ½ bore, 6 # 3, 6 # 4, 5" pin blades inc.	10.00
1 V-Belt for Scroll saw	1.00
1 Utility flexible shaft assembly, consisting of:	
1 Ball-bearing hand piece	1.00
1 Casing	1.00
1 Core	1.00
1 Motor coupling	.25
1 Grip for shaft	.25
1 Drill chuck adapter	.25
1 Sanding drum	1 00
1 Abrasive belt for drum	.10
1 Sanding disc	.75
1 Rubber back for disc	.25
6 Abrasive discs	.25
1 Floor waxing brush	.75
1 4" fine wire brush wheel	.75
1 Grinding-wheel guard	.50

Bench Tools

1 Bit, screw driver, 5"	.30
6 Bits, auger, ¼" @ .40, ⅜" @ .40, ½" @ .50, ⅝" @ .60, 1" @ .90	2.40
1 Bit brace, open ratchet, alligator jaw, 10" sweep	3.75
1 12" Bit extension holder, up to ¾" bit	2 25
2 Bench legs, steel, @ $3.45	6.90
3 Bench boards, yellow pine, 2"×12"×10'	3.00
1 Chisel, cold, ¼"	.20
1 Chisel, cold, ½"	.30
1 Chisel, cold, 1"	.75
1 Chisel, wood, ⅛" butt	1.00
1 Chisel, wood, ¼" butt	1.00
1 Chisel, wood, ½" butt	1.05
1 Chisel, wood, ¾" butt	1.20
2 Clamps, wood, small, @ 15c., local	.30
2 Clamps, wood, large, @ 25c., local	.50
1 Cutting tool for lathe, ½" skew	1.25
1 Cutting tool for lathe, ½" spear point	1.25
1 Cutting tool for lathe, ½" gauge	1.25
1 Countersinker, rose type	.45
1 ½ pint can cement, quick drying	.39
1 Drill, wall	8.95
1 Drill, hand speed drill, 3¼" gear, chuck to ¼" and 8 bits, 1/16", 5/64", 3/32" 7/64", 1/32", 9/64", 5/32", 11/64" included	3.70
1 Drill star ¼" to 12"	.40
8 Dies, bolt, 1/16", ⅛", 3/16", ¼", 5/16", ½", 9/16", 11/64" @ .25	2.00
1 Die stock	.75
1 Emery hand driven with emery wheel W.T. 86	1.00
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2 Files, round, 1-10" @ .25c; 1-6" @ .15 ..	.40
1 File, triangular, 6"	.15
1 Gauge panel, 17"	.50
1 Graphite lubricant for power-driven equip, 4 oz. V-tube	.25
1½ pt LePage glue	.60
1 Hatchet, 13"	1.00
1 Hammer 13", 16 oz., curved claw, octagonal neck and pall	1.85
1 Hammer, tack, 10¾" x 4" head	.55
1 Hammer, bald pien, 16 oz., size 0	1.25
1 Hand Tool set, including 6 brad awls, reamer, chisel, scratch awl, screw-driver, tack puller	1.50
1 Knife, putty, 1⅜" x 3¾" steel blade	.35
1 Level, iron, 6"	1.00
1 Mallet, wood, 10"	.59
1 Oil stone	.25
1 Oil can	.10
1 Can plastic wood	.35
1 Punch, prick, 4"	.20
1 Punch, pin, 9"	.40
1 Punch, solid, 6"	.30
1 Pliers, side cutting, 6" standard	1.25
1 Pliers, long nose, 6" standard	1.30
1 Pliers, staple puller, 10" pipe grip	1 90
1 Pencil, carpenter	.10
1 Rule, 6 feet	.25
1 Rule, 1 ft.-4 fold, divided 8th, 10th, 12th, 16th	.90
1 Screw-driver, 6½"	.25
1 Screw-driver, 6¾" ratchet	.95
1 Spokeshave, adjustable 10" x 2⅛"	.75
1 Square, try and mitre, 4½" x 3½"	.45
1 Square, try and mitre, 10" x 6"	1.05
1 Saw, hand, 24" hand skew back 8 point	2.25
1 Saw, hack, 10" frame	.65
12 Saw blades, hack, 10"	.80
1 Saw, coping	.25
12 Saw blades, coping, for hand saw	.15
1 Saw, hand circular	25
2 Saw blades, for circular hand saw @ 10	.20
1 Saw blade, circular, 6" diam., ½" hole	2.50
1 Snips, circular cutting, 7"	1.00
1 Snips, straight, 7"	.75
1 Soldering iron (electric)	1.00
1 Can soldering paste	.25
1 Roll solder ¼"	.25
1 1" Trammel points, bronze, straight edge	2.10
8 Tops, 1/16", ⅛", 3/16", ¼", 5/16", ½", 9/16", 11/64" @ .25	2.00
1 Vice, machinist's, stationary base, 2" steel jaw	2.65
1 Vice, woodworker's, 4½" jaw	3.00
1 Vice, pin driver, hand, Walker-Turner	.35
1 Wrench, 8" pipe	.65
1 Wrench, 14" pipe	1.50
1 Wrench, 8" double open end adj.	1.50
1 Wrench, monkey, 11"	1.25
1 Wheel, bakelite metal cutting, 6" diam. ½ hole	1.05
1 Plane, block, 7" x 1⅝" adj.	1.65
1 Plane, bench, 14" x 2" adj.	5 40
Total	$199.98

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I WAS born May 9th, 1905, at Canesville, Ohio. At the age of eight, my family moved to Columbus where I attended public school. In 1923 I completed a commercial course at the Columbus High School.

Robert O. Downs

My interest in tools was awakened in the lower grades of public school. My manual training courses impressed upon me the fact that the primary use of tools was not to destroy, but to create. As a very young child, my actions seemed to indicate that tools were created for the former purpose.

My enthusiasm for my new found friends, tools, grew to such an extent that the money for my lunch went toward assembling a kit of tools.

At the present time I am Credit Manager in the music store of Otto B. Heath. President of the National Association of Music Merchants.

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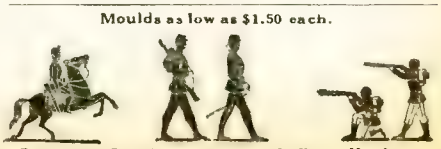

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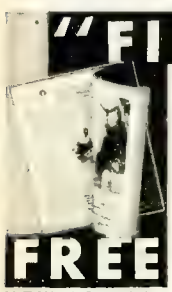

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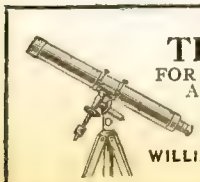

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(While every precaution is taken to insure accuracy, we cannot guarantee against the possibility of an occasional change or omission in the preparation of this index.)

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Why Mr. Downs chose the tools that he did:

To the fellow like myself, who purchased his first tools with money saved from a school lunch allowance, $50.00 seems an adequate amount to allow for equipping the home work shop.

With the tools I have selected, all the necessary shop operations possible with hand tools, both woodworking and metal working, may be accomplished. With them also the various repair and installation jobs about the home can be easily handled. Electrical wiring, plumbing, painting and varnishing, glazing and maintenance of tools are all specially provided for and in addition the kit will take care of a number of miscellaneous jobs. While no attempt is made to enumerate individual operations, may I call your attention to the excellence and completeness of the metal working equipment.

Two saws are provided for metal cutting, the coping saw (when provided with the proper blades) and the hacksaw. The edge tools, chisels, snips, etc., are adequate. A large assortment of drills and a countersink are provided. Light brazing, annealing, tempering and forging may be accomplished and all but the heaviest soldering operations. The vise selected is portable—not only because it might be inconsistent or unfair to provide another kind unless one also provided a bench, but because this type is more versatile.

Whether or not a tool was adequate to accomplish an operation was, of course, my first consideration when selection was made. Safety, ease of operation, rapidity, durability and value were other points receiving full attention. Since I consider the judges better qualified than I to answer these questions I have contented myself with simply listing these points upon which the tools were chosen. The excellent finish, balance and design of these tools are indications of quality which will be readily appreciated. We must depend upon other indications when considering the hidden points of quality. We refer to points such as temper, dependability and pride of ownership which are either invisible or intangible. In my opinion the best indications of these points of quality are long established manufacturers, famous trademarks and national advertising.

No manufacturer can endure for over half a century unless the public is well served. A large majority of the tools on my list are made by firms established over fifty years ago.

It is safe to say that no manufacturer can afford to advertise tools for the profit of but one sale, and continued patronage is based upon satisfaction. Our leading magazines openly stake their reputations on the quality of the products they advertise and acknowledge their responsibility to their subscribers in case of misrepresentation.

Mr. Downs' List of Tools

1 Punch, size C, 1/8" at top of tapered point, 4" in length, knurled grip	.25
1 Carborundum oilstone, size 5" x 2" x 5/8", medium grit	.75
1 Set drills, 11 drills to the set, 1/16" to 1/4", carbon steel, round shanks	1.05
1 Clamp vise, 3" jaws, open 2¾", sliding bar type, anvil on fixed jaw	2.00
1 Auto wrench, 9" long, 3" capacity, forged steel, polished	.75
1 Screw-driver, 5" blade, square rod runs through handle. For heavy work	.45
1 Compass saw, 12" blade, applewood handle	1.00
1 Crosscut saw, 26" long, 8 point straight back, regular pattern	3.10
1 Plierench, 8½" long, gear type, parallel jaws, wire cutters, 3 interchangeable jaws for nuts, pipe and wire. Capacity 1½"	3.50
1 Cold chisel, ½" cut, 3/8" stock, 5" long	.26
1 Countersink, single-lipped with bit brace shank, ½". For wood or metal	.42
1 Hacksaw, capacity 8" to 12" blades, 3" throat, nickel finish, steel pistol grip handle	1.20
4 Auger bits, extension lip, double thread screw point, 3/8" .42; ½" .42; ¾" .59; 1" .80	2.23
1 Car bit, extension lip, single thread screw point, length 12" × 5/8"	.84
1 Ratchet brace, 10" sweep; chuck holds round or square shanks 1/8" to ½" Ball-bearing head	5.15
1 Coping saw, flat spring steel frame, blades can be turned and locked at any angle without removal. Depth 4¾"	.90
1 Hand drill, capacity 0" to ¼" round shanks drills, single speed, steel frame. Length 11¼"	1.50
1 File, 5" slim taper saw file, single cut	.20
1 File, 8" mill bastard cut	.25
1 File, 6" round single cut bastard	.20
2 File handles, No. 4, white birch shellaced-spun ferrules @ 5c. each	.10
1 Screw-driver, 3½" cabinet style blade. Intended for light work	.35
1 Copper-handle wire ferrule	.05
1 Soldering copper, forged, standard shape, square point. Weight, 1 lb. per pair	.35
1 Tinners' Snips, length 12"-3" cut. Combination, circular and straight cutting	1.50
1 Ripping hammer. Weight 1 lb. 4 oz. Size 11; adze eye, bell face	1.75
1 Shingling hatchet, size 1; weight, 1 lb. 1 oz., 3½" bit	1.75
1 Glass cutter. One-piece steel turret head, 6 cutter wheels	.30
1 Putty knife. Flexible blade, round, varnished wood handle	.15
2 Chisels, bevel edge, blade 4½" long. Shank goes through handle forming head, ¼" wide	1.15
Same as above, but blade is ¾" wide	1 40
1 Smooth plane, No. 4, 9" long, 2" cutter, smooth bottom; cutter adjustable endwise and sidewise	4.20
1 Zig-zag rule, 4 ft. long. Concealed joints, direction arrows and strike plates	.45
1 Combination square, 9" detachable graduated blade, with level glass	1.35
1 Nail set, size C, 3/32" point, round knurled grip, square head, length 4"	.15
1 "C" clamp, 5" capacity, steel screw, folding handle	.65
1 File and tool handle, steel set screw. Capacity 3/8" round, square or flat	.17
1 Pipe wrench, 14" long, capacity ¼" wire to 1½" pipe. Steel handle	2.00
1 Blow torch. Capacity 1 quart. Single needle burner, removable soldering hook	4.00
1 Tool grinder. Enclosed spiral cut gears	1.00
1 Grinder treadle. Removable, sliding bar adjustable to bench height	.25
1 Varnish brush, width 2¾". Length of bristles clear of swaged ferrule 3⅛", chisel ends	.90
Total	$49.97

Magic

(*Continued from page* 48)

lifts it high above his head, and after rubbing his hands about the orange for a few minutes, slowly draws them apart. They are empty. The orange has miraculously disappeared. This is how he did it. In picking the orange from the table, he drops it into his lap, where it is caught in a black bag which he holds between his knees. A ring has been sewed to the mouth of the bag to keep it open, in position to receive the fruit. A strong elastic attached to the bag carries the fruit out of sight, beneath the wizard's coat. That is where the free end of the elastic has been attached.

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Scientific Book Reviews

THE WORLD IN THE AIR, by Francis T. Miller. Published by G. P. Putnam's Sons, New York, N. Y. Two Volumes. Price $15.00.

The history of aviation is unfolded before your eyes as you turn the pages of "The World in the Air." A complete survey of man's conquest of the air, the book makes no pretense of delving into technical achievements.

The author draws upon mythological and legendary sources for his illustrations and explanation of the first attempts to fly. From thence he graphically portrays the successive steps that led to the development of our contemporary air giants and organizations. So exhaustive is the compilation that it can be said almost with certainty that it will be regarded as a veritable encyclopedia and reference library by students interested in the development of aviation. Not only is the content material noteworthy, but the arrangement of the work will please even the most exacting book lover.

DESIGNING HEATING AND VENTILATING SYSTEMS, by Charles A. Fuller. Published by Scientific Book Corporation, New York City. 244 pages. Price $3.00.

It is most encouraging to read a textbook and discover that although the author intended to provide a source of information for the student, he has also included sufficient practical problems to interest construction engineers. The definitions, inserted wherever new material is discussed, contribute not a little bit to the effectiveness of the book.

Mr. Fuller feels that he has simplified the explanations and formulæ contained in his work, so that the man without benefit of higher education will experience no difficulty in understanding the text.

We disagree.

To our mind there are too many instances where it must be admitted that higher learning is a prerequisite to understanding.

Had the author stated that he reduced the subject material to a form as easily assimilated as possible we could have signified our accordance.

EXPERIMENTS IN ATOMIC SCIENCE FOR THE AMATEUR, by James L. Clifford. Published by the Gorham Press, Boston, Mass. 119 pages. Price $1.50.

The subject of radioactivity and atomic structure has always been regarded as an abstract theoretical study which only skilled mathematicians could approach with any hope of understanding. Add to this general impression the fact that the purchase of radium is an impossibility for most folk and the prevalent idea that only the pure substance can be used for experimental purposes and it is easily understood why the amateur has left this field of endeavor severely alone.

To relieve the situation and remedy the condition is the aim and purpose of the present work. The author informs us that the relatively cheap, impure salts containing only minute traces of radioactive substances can be successfully employed in carrying out investigations. Mr. Clifford shows us how to build our own apparatus—details numerous interesting experiments—recapitulates much of the data extant on the subject and brings up questions that will stimulate the reader to further research.

RADIO AND ITS FUTURE. Edited by Martin Codel. Published by Harper & Bros., New York City. 349 pages. Price $4.00.

Mr. Codel has given us a kaleidoscopic view of the development of radio art, industry and technique. It would be expecting too much to ask one man to detail and explain how this infant industry has grown in a few years to such amazing proportions and entered into the lives of each and every one of us.

The editor availed himself of the services of men who have reached the top in their particular departments of the industry and can base their statements and observations on personal experience. Contributors include Major Gen. James G. Harbord, Lee DeForest, O. H. Caldwell, H. P. Davis, Merlin Hall Aylesworth, David Sarnoff, Fredrick A. Kolster, and other notables. The whole work is a well-knit exposition that will surely answer many of the hows, whys, and wherefores that arise in the mind of the broadcast listener.

AFRICA VIEW, by Julian Huxley. Published by Harper & Bros., New York City. 456 pages. Price $5.00.

Julian Huxley journeys through Africa and records his impressions. In his writings, as we read them, he reveals himself not only as a thorough scientist, the individual who has the interest and ability to dive deep beneath the surface, but also gives us a self-portrait of a broad-minded, fair human being.

His picture of Africa is clear and is given from many unusual viewpoints. In so far as the Dark Continent is concerned there is nothing startling about this work. Travel stories have been written before and many of them have described Africa.

But here we have a whimsical, remarkably penetrating account not only of a man's journey but of what he felt. Huxley's journal records the activities of the natives, European officials, and sundry other folk classes whom he met not as so many separate physical movements but as the visible manifestations of hope, despair, aspiration, idealism and knavery. A big man has visited a big continent.

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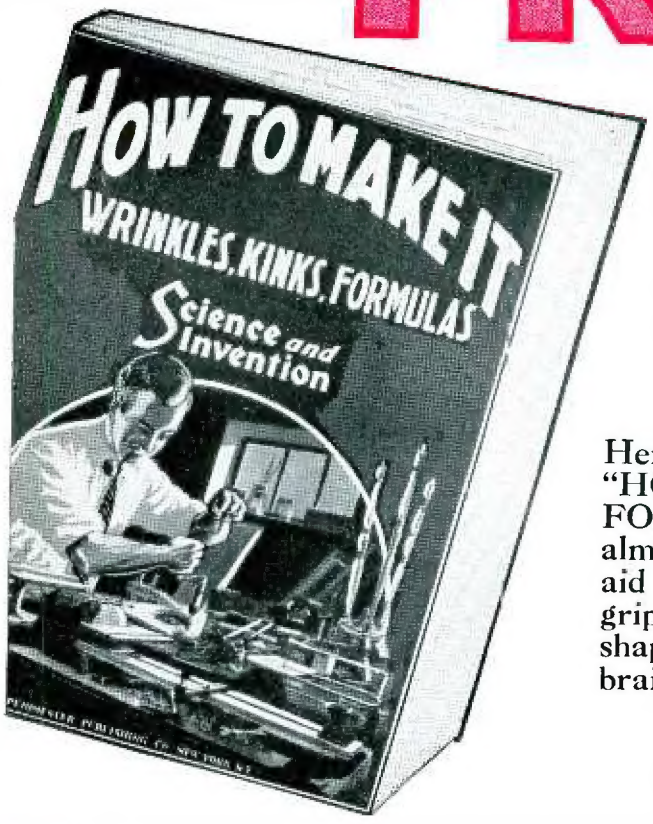

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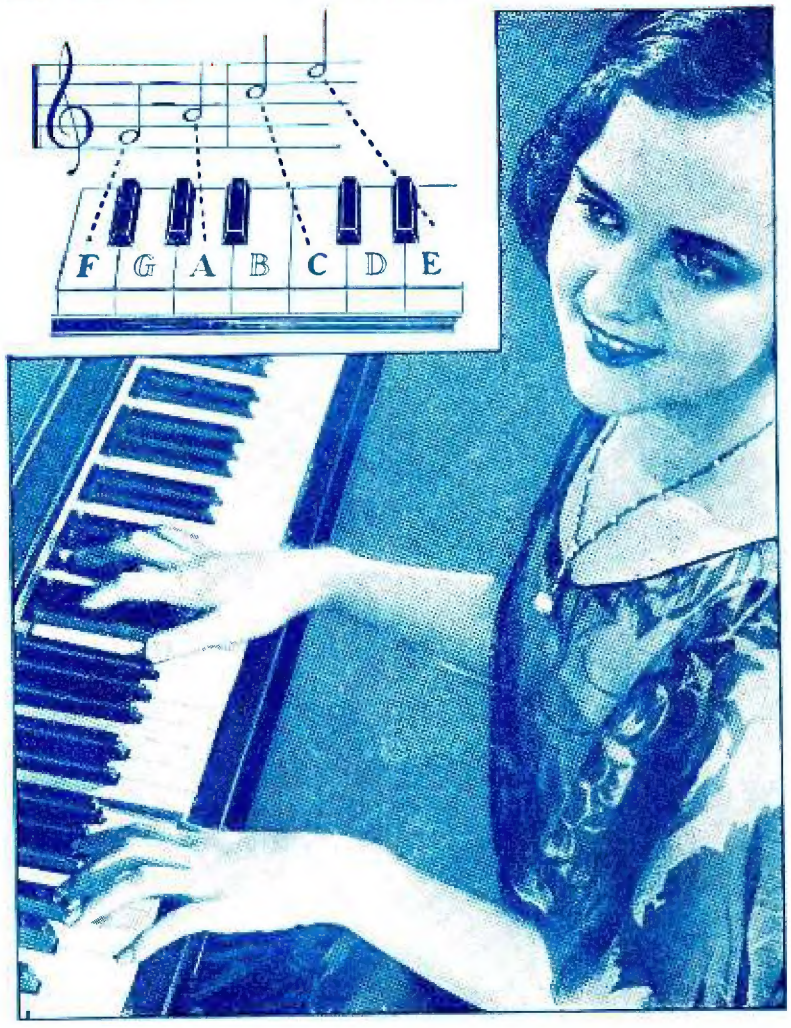

DOES the very thought of harsh-sounding scales—compulsory practice and impatient teachers put a damper on your ambition to become a popular musician?

With such excuses as—"It takes too long"—"It costs too much"—"I don't know the first thing about music"—are you alibiing yourself right out of good times and a highly enjoyable attainment?

You're the Boss

You'd take up music in a minute, wouldn't you—if you thought there was a way of learning that made *every* lesson easy—that allowed you to study *when, where and as much or little as you please*—that encouraged rapid progress—that did not cost too much?

All right. Such a method is far from being imaginary. It is so real that inside of a few short months you can learn to play your favorite instrument. Without taking lessons from a teacher! Without paying expensive fees! Without any tiresome technique or dry-as-dust exercises to struggle through!

Thank the U. S. School of Music for the utter simplicity of this remarkable system. It removed completely the difficulty, boredom and extravagance from music lessons. It made possible the reading and playing of music from print and picture instruction. Now to begin your musical career you don't even have to know "do" from "re" or a sharp from a flat. Isn't that good news?

What Could Be Easier?

Your own home is your studio. The lessons come to you by mail. They consist of complete printed instructions, diagrams . . . *and all the music you need without extra charge.*

A sheet of music is not a riddle to you. You never have to *guess* what's right or wrong—*you know!* First you are told how a thing is done. Then a picture shows you how, then you do it yourself and hear it. Small wonder it's *twice as easy* as old-fashioned private teacher method.

Play Your Favorites

Instead of just scales you are playing real tunes from actual notes — right from the very first lesson on. Sooner than you realize you will be bringing cheer to the folks at home with your playing.

What Instrument For You?

Piano	Violin
Organ	Clarinet
Ukulele	Flute
Cornet	Saxophone
Trombone	Harp
Piccolo	Mandolin
Guitar	'Cello

Hawaiian Steel Guitar
Sight Singing
Piano Accordion
Italian and German Accordion
Voice and Speech Culture
Harmony and Composition
Drums and Traps
Automatic Finger Control
Banjo (Plectrum, 5-String or Tenor)
Juniors' Piano Course

Gradually you gain confidence and professional expression. Then parties, popularity, orchestra work follow in short order. You'll know how good it feels to be out of the wallflower class and into the whirl of things—to be able to provide musical enjoyment for others whenever you are called upon.

Don't be afraid to begin your lessons at once. Over six hundred thousand people learned to play this modern way—and found it easy as A-B-C. Forget that old-fashioned idea that you need special "talent." Just read the list of instruments in the panel, decide which one you want to play, and the U. S. School will do the rest. And bear in mind no matter what instrument you choose, the cost in each case will average the same—just a few cents a day.

Free Book and Demonstration Lesson

Our wonderful illustrated Free Book and Free Demonstration Lessons explain all about this remarkable method. They prove just how anyone can learn to play his favorite instrument in half the time and for just a fraction of what old slow methods cost.

If you really want to learn to play—if new friends, good times, social popularity, and increased income appeal to you—take this opportunity to make your dreams come true. Now! Sign the coupon and send it before it's too late. Instruments supplied when needed, cash or credit. U. S. School of Music, 305 Brunswick Bldg., New York City.

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Please send me your free book "Music Lessons in Your Own Home," with introduction by Dr. Frank Crane. Free Demonstration Lesson and particulars of your easy payment plan. I am interested in the following course:

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Have you above instrument? ....

Name .....

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